Engineering Library

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The Engineer.

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VOL. CXLVII.—No. 3828] LONDON: FRIDAY EVENING, MAY 24, 1929 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—
SCHEDULE 1.—LOCOMOTIVES: 18 Broad Gauge, 2 Metre Gauge.
SCHEDULE 2.—52 LOCOMOTIVE BOILERS, with Cylinders and other Equipment.
SCHEDULE 3.—BRIDGE WORK: Eight Spans of 100ft.
Tenders due as follows :—
Schedules 1 and 2, 14th June, 1929.
Schedule 3, 2nd July, 1929.
Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule. 2010

Crown Agents for the COLONIES.
COLONIAL GOVERNMENT APPOINTMENTS.
APPLICATIONS from qualified candidates are INVITED for the following POSTS :—
M/1539.—ENGINEER REQUIRED by the GOVERNMENT of HONG KONG for the Public Works Department for three years' service, with possible permanency. Salary £460, rising to £500 a year by annual increments of £20, and thereafter, if the appointment becomes permanent, rising by annual increments to a maximum of £1000 a year, payable in dollars under the compensation scheme at present in force at a favourable rate of exchange. Free first-class passages provided. Candidates, 25 to 30 years of age, single, must have passed examinations for Sections A and B of the A.M.I.C.E. Diploma or hold professional qualifications accepted by the Institution of Civil Engineers as exempting from those examinations. Must be good draughtsmen and be proficient in land surveying and levelling. Should have had experience in waterworks, maintenance and administration work of a large city, including house services, meterage, mains, waste prevention and general distribution, and the preparation of plans, specifications and estimates for waterworks construction, such as storage and service reservoirs, filter beds, &c.
M/1416.—ASSISTANT ENGINEERS REQUIRED by the GOVERNMENT of NIGERIA for the Public Works Department for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480 a year for the first three years, then £510, rising by annual increments to £920. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates must have attained the age of 21½ years on the date of appointment, and should preferably have attained the age of 22½ and must not be over 35 years of age. Must have obtained an Engineering Degree at a recognised University or have passed Sections A and B of the A.M.I.C.E. examination or have passed the Associateship in Civil Engineering of the City and Guilds Institute, or possess such other Degree or Diploma or Distinction in Engineering as may be considered satisfactory. Candidates whose qualifying Diplomas have been obtained without a College course should have had three years' practical experience of civil engineering under a qualified civil engineer. It is preferred that all candidates should have had two years' practical experience on good engineering work, subsequent to taking their Degree or completing their articles, but under certain conditions this may be waived in the case of candidates in possession of an Engineering Degree.
Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting the reference number against the appointment for which application is made. 1980

Electricity Commission.
ENGINEERING INSPECTORATE.
The Electricity Commissioners invite APPLICATIONS from qualified persons for the POSITION of a PRINCIPAL ENGINEERING INSPECTOR.
Applicants must be of British nationality and not more than 50 years of age, and should preferably be Corporate Members of the Institution of Civil Engineers and of the Institution of Electrical Engineers. They must possess a sound knowledge of Modern Power Station Practice, and of the Transmission and Distribution of Electricity at High and Low Voltage and a knowledge of the Provisions of the Electricity (Supply) Acts, 1882 to 1928.
The appointment will be on an established pensionable basis, and will be subject to a probationary period of one year.
The salary attached to the post is £1000 per annum (plus bonus on the Civil Service Scale, which at the present cost of living figure amounts to £205 per annum), rising after confirmation of the appointment by annual increments of £50 to £1200 per annum.
Applications, stating experience and qualifications, accompanied by not more than three recent testimonials and marked "Principal Engineering Inspector," should be forwarded to the SECRETARY, Electricity Commission, Savoy-court, Strand, W.C. 2, not later than Saturday, 8th June, 1929. 2006

INDIAN SERVICE OF ENGINEERS AND INDIAN RAILWAY SERVICE OF ENGINEERS.
The Secretary of State for India in Council will, in the near future, APPOINT NINE ASSISTANT EXECUTIVE ENGINEERS (including, if possible, one Burman, who will be appointed to the India recruited branch in Burma) to the Indian Service of Engineers, and THREE ASSISTANT EXECUTIVE ENGINEERS to the Indian Railway Service of Engineers. Except for the Burman appointment, every candidate must be an European British subject of non-Asiatic domicile.
Candidates must have attained the age of 21 years and must not have attained the age of 24 years in the case of those applying for appointment to the Indian Service of Engineers, and 25 years in the case of those applying for appointment to the Indian Railway Service of Engineers, on 1st January, 1929.
They must either (1) have obtained one of certain recognised University Degrees or Distinctions in engineering, or (2) have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers or been exempted by the Institution from such examination, or (3) have passed the Associateship in Engineering of the City and Guilds Institute (Imperial College of Science and Technology, South Kensington), or (4) produced the required evidence that they are otherwise eligible under the Regulations. They should in addition have had about one year's approved practical experience in engineering.
Applications from candidates must reach the India Office not later than 30th June, 1929. Printed forms, together with information regarding the conditions of appointment, may be obtained from the SECRETARY, Services and General Department, India Office, Whitehall, S.W. 1.
India Office,
April, 1929. 1722

The Engineer

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PUBLIC NOTICES

Wanted for the Indian Ordnance Factories, THREE ASSISTANT WORKS MANAGERS. Salary Rs. 600 plus £25 sterling overseas pay per mensem, rising by annual increments of Rs. 50 per mensem to Rs. 800 plus £25 per mensem. The appointments are non-pensionable, but there is a Provident Fund, subscription to which is compulsory. Free passage to India is granted, and quarters, if available, are provided at a rental not exceeding 10 per cent. of salary. An agreement for five years will be entered into in the first instance, and the selected officers will be required to proceed to India early in September, 1929.
Candidates must have been well educated and have attained 24 years of age, preference being given to suitably qualified candidates whose age does not exceed 40 years.
The following are the factories to which the officers will be posted, with the technical qualifications required :—
(1) Metal and Steel Factory, Ishapore :
Candidates must possess either a University Degree of Non-ferrous Metallurgist or an equivalent Diploma of a recognised Institute. They must, in addition, have had not less than five years' workshop experience in brass casting and rolling and/or rod and tube drawing shops, in two of which shops at least they should have had experience in the handling of labour.
(2) Metal and Steel Factory, Ishapore :
Candidates must possess either a University Degree in Engineering or an equivalent Diploma of a recognised Institute. They must, in addition, have had not less than five years' practical experience with a firm of repute (preferably in an armament workshop), during which period they must have had experience in the drawing-office, in estimating, and in the handling of labour.
(3) Rifle Factory, Ishapore :
Candidates must possess either a University Degree in Engineering or an equivalent Diploma of a recognised Institute. They must, in addition, have had a further five years' experience in works engaged in the manufacture, on mass production or repetition lines, of small components. Teaching experience is desirable, and a bachelor will be preferred.
Applications from candidates who do not possess the requisite qualifications cannot be considered.
Applications should be submitted as soon as possible before 1st June, 1929, on forms to be obtained from the SECRETARY, Military Department, India Office, Whitehall, S.W. 1. All communications should be marked "Ordnance Recruitment." 1886

PUBLIC NOTICES

Department of Scientific and Industrial Research.
JUNIOR ASSISTANT (Engineer) REQUIRED at the Fuel Research Station, East Greenwich. Candidates must have a good Honours Degree in Engineering or equivalent qualification, and some research or practical experience. Scale of salary £175-15-£235 per annum plus Civil Service bonus; initial pay approximately £265. Superannuation provision will be made under the Federated Superannuation System for Universities.
Further particulars and application forms can be obtained from the SECRETARY, Department of Scientific and Industrial Research, 16, Old Queen-street, Westminster, S.W. 1, to whom the latter should be returned not later than June 6th. 1949

University of the Witwatersrand, JOHANNESBURG, SOUTH AFRICA.
LECTURER IN CIVIL ENGINEERING.
APPLICATIONS are INVITED for the above POST.
Experience in Testing Materials and ability to conduct Laboratory Classes will be a recommendation.
SALARY.—£464 per annum, rising by annual increments of £26 5s. to £569 per annum. Participation in the Provident Fund is compulsory.
TRANSPORT.—£60 will be allowed for transport expenses, subject to a proportionate refund in the event of the lecturer terminating his agreement within 2 years of the date of assumption of duty.
DUTIES.—The successful applicant will be required to assume duty on the 8th August or as soon as possible thereafter.
Candidates should state age and give full particulars of academic career and practical experience.
Applications, together with copies of testimonials, all in triplicate, must reach the SECRETARY, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar-square, London, W.C. 2, from whom further particulars may be obtained, not later than Tuesday, 4th June, 1929. 1856

PUBLIC NOTICES

Armourers' and Brasiers' Company.
LECTURES IN METALLURGY.
The Company have arranged for the following Lectures to be delivered :—
At the ROYAL SCHOOL of MINES, Prince Consort-road, South Kensington, S.W., at 5.15 p.m. on 27th May, the 3rd and 10th June, 1929, by
Dr. COLIN J. SMITHELLS, M.C., D.Sc.,
on
"MINOR CONSTITUENTS IN INDUSTRIAL METALS AND ALLOYS."
At the Northampton Polytechnic Institute, St. John-street, Clerkenwell, E.C., at 7 p.m. on 29th May, the 5th and 12th June, 1929, by
GEO. PATCHIN, Esq., A.R.S.M., M. Inst. M.M.,
on
"ENGINEERING ALLOYS."
Admission free, without ticket. 1938

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY
(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MACHESTER).
APPLICATION FOR APPOINTMENT AS LECTURER IN METALLURGY AND ASSAYING.
The Governing Body invites APPLICATIONS for a LECTURESHIP in METALLURGY and ASSAYING in the College of Technology, with the title and status of Lecturer in the University of Manchester.
Salary £600 per annum.
Conditions of appointment and form of application may be obtained from the Registrar, College of Technology, Manchester. The last date for the receipt of applications is Thursday, 13th June, 1929.
Canvassing, either directly or indirectly, will disqualify a candidate for appointment.
B. MOUAT JONES,
1954 Principal of the College.

Lincoln Technical College.
PRINCIPAL: A. E. COLLIS, M.I. Mech. E.
APPLICATIONS are INVITED for a FULL-TIME TEACHER in the Mechanical Engineering Department for the Part-time Day and Evening Classes, to commence duties on 1st September, 1929. Candidates must possess a Degree (or its equivalent) and have had a good workshop training, laboratory and teaching experience.
An important part of the work is the preparation of students for National Certificates in Mechanical Engineering, in which the local engineering firms are particularly interested.
Salary in accordance with the Burnham Scale for Teachers in Technical Schools.
Form of application, which should be returned not later than May 31st, will be forwarded by the PRINCIPAL on receipt of stamped addressed envelope. 1921

Brighton Intercepting and OUTFALL SEWERS BOARD.
Contractors desirous of tendering for the SUPPLY and ERECTION of THREE VERTICAL SPINDLE ELECTRICALLY OPERATED PUMPS of at least 50 H.P. each should apply to the undersigned not later than May 27th, 1929.
A deposit of £2 2s. is required with the application, which will be returned on the receipt of a bona fide Tender.
The lowest or any Tender will not necessarily be accepted.
D. EDWARDS,
Engineer to the Board.
Town Hall, Brighton,
21st May, 1929. 1976

Central London School DISTRICT.
TENDERS FOR ELECTROMOTORS, SWITCHGEAR, &c.
The Managers of the Central London School District invite TENDERS for the SUPPLY of FOUR ELECTROMOTORS, SWITCHGEAR, EQUIPMENT, also STEEL SHAFTING, LEATHER BELTING, &c.
Firms desiring to Tender are requested to apply for specification and form of Tender to the undersigned.
Sealed Tenders are to be delivered at the offices of the Central London District School, Greenford-avenue, Hanwell, W. 7, addressed to the undersigned, not later than the 8th June.
The Managers do not bind themselves to accept the lowest or any Tender.
By Order,
GEORGE P. MORRELL,
1986 Clerk to the Managers.

Derbyshire County Council.
NEW COUNTY OFFICES.
The Council invite TENDERS for approximately 50 TONS of STRUCTURAL STEEL WORK, to be supplied and erected at Derby. Copies of the form of Tender, specification and drawings can be obtained upon application to Mr. G. H. Widdows, F.R.I.B.A., County Offices, S. Mary's Gate, Derby.
Sealed Tenders, addressed as noted on the form, must be delivered at the offices of the Council not later than Ten o'clock on Friday, 31st day of May.
The Council do not bind themselves to accept the lowest or any Tender.
H. WILFRID SKINNER,
County Solicitor.
County Offices,
S. Mary's Gate, Derby. 1920

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PUBLIC NOTICES

Liverpool Corporation Water-Works.

THIRD INSTALMENT, VYRNWY SUPPLY.
COTEBROOK-NORTON SECTION.
CONTRACT No. 9.

The Water Committee of the Liverpool Corporation is prepared to receive TENDERS for the SUPPLY of about 5 2-3 Miles of 42in. Bitumen-lined STEEL PIPES, together with a number of Specials.

Specification and drawings may be inspected at the Water Engineer's Office, Alexandra-buildings, 55, Dale-street, Liverpool, on and after Monday, the 27th May, 1929. Copies of the specification and form of Tender may be obtained upon payment of a deposit of Five Guineas, which will be repayable upon receipt of a bona fide Tender, and return of the documents and drawings issued.

Tenders, endorsed "Tender for Third Instalment Pipes," are to be sent through the post in a sealed envelope addressed to "The Town Clerk, Municipal Buildings, Liverpool," so as to be delivered not later than Twelve o'clock Noon on Monday, the 17th June, 1929.

The Water Committee do not bind themselves to accept the lowest or any Tender.

WALTER MOON,
Town Clerk.

Municipal Buildings, Liverpool,
21st May, 1929. 1989

Manchester Corporation.

The Rivers Committee invite TENDERS for the CONSTRUCTION of EFFLUENT CULVERT and SURPLUS SLUDGE MAIN (DAVYHULME SEWAGE WORKS EXTENSION, WORK NO. 3A).

Plans may be seen and specification, bill of quantities, and form of Tender obtained on or after Monday, 27th May, 1929, on application at the City Engineer's Office, Town Hall, Manchester, on payment to the City Treasurer of £5 5s., which sum will, after the Corporation have come to a decision upon the Tenders received, but not before, be returned to the person submitting a bona fide Tender. All cheques or postal orders are to be made payable to the order of "The Corporation of Manchester."

Tenders, enclosed in the official envelope and addressed to the "Chairman of the Rivers Committee," are to be delivered at the City Engineer's Office not later than 9.30 a.m. on Thursday, the 13th day of June, 1929.

The Corporation do not bind themselves to accept the lowest or any Tender.

F. E. WARBRECK HOWELL,
Town Clerk.

Town Hall, Manchester,
22nd May, 1929. 2007

Metropolitan Borough of SAINT PANCRAS.

ELECTRICITY DEPARTMENT.

TENDERS are INVITED for the SUPPLY and FIXING of an ELECTRIC MOTOR-DRIVEN CENTRIFUGAL PUMP capable of discharging 1,500,000 gallons per hour of canal water for condensing purposes.

Specification and drawing may be obtained on the payment of £1, which will be returned on receipt of a bona fide Tender, from the offices of the Electricity Department, 57, Pratt-street, Camden Town.

The Council do not bind themselves to accept the lowest or any Tenders.

F. V. CREED,
Town Clerk.

Town Hall, Pancras-road, N.W. 1. 1838

Metropolitan Borough of SAINT PANCRAS.

ELECTRICITY DEPARTMENT.

TENDERS are INVITED for the ERECTION of an ADDITION to the CONDENSING WATER PUMPING STATION, including Pump House Inlet, Screen Pits and Canal Wall, also Reinforced Concrete Additions to the Discharge Outlet to the Canal.

Specifications and drawings may be seen at the offices of the Electricity Department, 57, Pratt-street, Camden Town, and forms of Tender obtained on the payment of the sum of £1, which will be returned on receipt of a bona fide Tender.

The Council do not bind themselves to accept the lowest or any Tender.

F. V. CREED,
Town Clerk.

Town Hall, Pancras-road, N.W. 1. 1839

Metropolitan Borough of SAINT PANCRAS.

ELECTRICITY DEPARTMENT.
MOTOR CONVERTER.

TENDERS are INVITED for ONE 1000-kW MOTOR CONVERTER.

Specification and form of Tender may be obtained on application at the offices of the Electricity Department, 57, Pratt-street, N.W. 1, on payment of £1, which will be returned on receipt of a bona fide Tender.

Sealed Tenders to be sent in not later than Twelve Noon on Thursday, the 6th June, 1929, to the undersigned, and endorsed "Tender for Motor Converter."

The Council do not bind themselves to accept the lowest or any Tender.

F. V. CREED,
Town Clerk.

Town Hall,
Pancras-road, N.W. 1. 1892

Stowmarket Urban District Council.

WATERWORKS.
CONTRACT NO. 1.
TO MANUFACTURERS OF WATER SOFTENING PLANT.

The Urban District Council of Stowmarket are prepared to receive TENDERS for the SUPPLY of a complete SOFTENING PLANT to be erected in existing buildings at their Station-road Pumping Station, Stowmarket.

The works included in the contract consist of the manufacture, supply, and erection of the whole of the works necessary to soften water under pressure at the rate of 12,000 gallons per hour from about 25 deg. to 11 deg. total hardness in accordance with the drawings, general conditions and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

Copies of the general conditions, specification and form of Tender may be obtained by the contractor at the office of the Engineers upon payment of £5 (cheque only), which will be returned on receipt of a bona fide Tender.

Tenders, in sealed envelopes endorsed "Tender for Softening Plant," must be delivered at my offices, Buttermarket, Stowmarket, on or before 10 a.m. on Friday, the 14th day of June, 1929.

The Council do not bind themselves to accept the lowest or any Tender.

(Signed) P. C. HAYWARD,
Clerk to the Council.

1979

Administrative County of LONDON.

The London County Council invites APPLICATIONS for the POSITION of DISTRICT INSPECTOR OF SCHOOLS (Technical Education) in the Education Officer's Department.

Salary £500 a year, rising by annual increments of £25 to £600 and thence by annual increments of £50 to a maximum of £800, together with temporary additions varying according to the cost of living. At the present time the total commencing salary is £671.

In exceptional circumstances the Council may be prepared to appoint the selected candidate at a point on the scale above the minimum.

DUTIES.—To conduct and assist in conducting the inspection of schools, colleges and institutes and to inspect and advise upon instruction in technical subjects. Candidates should possess engineering or similar technical qualifications as well as teaching experience.

Apply (clearly specifying position) to the Education Officer (C. 1), The County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope essential), for form of application, which must be returned not later than Monday, 10th June.

Canvassing disqualifies.

MONTAGU H. COX,
1935 Clerk of the London County Council.

PUBLIC NOTICES

Metropolitan Borough of BETHNAL GREEN.

SUPERINTENDENT-ENGINEER, PUBLIC BATHS AND WASHHOUSES.

The Council invites APPLICATIONS from married men, preferably between 35 and 45 years of age, for the APPOINTMENT of SUPERINTENDENT-ENGINEER at the new Public Baths and Washhouses, Bethnal Green. Inclusive salary £425 per annum plus apartments, fuel and light, valued for superannuation purposes at £85 per annum. Preference will be given to an ex-Service man.

The appointment will be subject to the Council's Superannuation Act, By-laws and Standing Orders, and the successful candidate must pass a medical examination.

Applications, on forms which will be sent by me on receipt of a stamped addressed envelope, must reach me at the Town Hall, Bethnal Green, London, E. 2, by 10 a.m. on Wednesday, the 5th June, 1929.

Canvassing will disqualify.

DAVID J. KEEP,
1961 Town Clerk.

ASSISTANT MECHANICAL ENGINEER.

The Gas Light and Coke Company

are prepared to receive APPLICATIONS from regularly trained Mechanical Engineers for the POST of ASSISTANT MECHANICAL ENGINEER at Beckton Works. Salary £450 p.a. Applicants must be competent to control men, and experienced in managing large workshops. Knowledge of modern practice in Steam, Electric, and Hydraulic Power Generation and Transmission, Railway Work, and Material Handling and Transport generally is essential.

Applicants must not be more than 35 years of age and should write not later than 14th June to the SECRETARY, Horseferry-road, S.W. 1, with details of training, qualifications and experience, stating when free to start. 1981

Wanted:—Distribution Engineer

for the Burma Electric Supply Co., Ltd., Mandalay.

Salary Rs. 600 per month.
Agreement 5 years.
First-class passage paid both ways.

Applications will only be considered from those having the following qualifications. Age not exceeding 30, unmarried.

Technical Education: Equal to Institution Electrical Engineers Exam. for Associate Members.

Practical Training: Have served an apprenticeship with an electrical concern of good standing.

Experience: Knowledge of the supervision of an outside department of a 3-wire D.C. supply system, and repairs and testing of meters and motors.

Preferably some experience of correspondence with consumers.

Apply in writing, with three copies of recent testimonials, to

SECRETARY,
Burma Electric Supply Co., Ltd.,
1, Queen Victoria-street, London,
Envelope to be marked "Distribution." 1972

Waterford Harbour.

WANTED, 10-TON TRAVELLING HAND CRANE.

The Commissioners for Improving the Port and Harbour of Waterford invite contractors to submit TENDERS on or before the 8th June, 1929, for the SUPPLY and DELIVERY on the Quay, Waterford, of a SECOND-HAND 10-TON, not less than 24ft. radius, Hand Power Operated HOISTING, SLEWING, and TRAVELLING CRANE, with change gear to hoist lesser loads than 10 tons at quicker hoisting and slewing speeds.

Firms tendering to furnish with their Tender full working drawings and detailed specification of the cranes they offer and state where crane can be inspected.

The lowest or any Tender will not necessarily be accepted.

For further particulars apply to
AUSTIN A. FARRELL,
Secretary and General Manager.

Harbour Office, Waterford,
15th May, 1929. 1937

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ADVERTISER, 1474, Machine Designer, Vacancy, THANKS ALL APPLICANTS, and intimates that VACANCY IS NOW FILLED. 1967 A

BOX No. 1702.—VACANCY for Tool Designer HAS NOW BEEN FILLED, and the advertiser wishes to thank all applicants. 1968 A

WANTED, Competent TECHNICAL EXPERT, with University Degree, for Steam and Gas Engine Design, Heat Transmission Calculations, Correspondence and Commercial Work.—Address, stating age, experience, references, and salary required, to GENERAL MANAGER, Galloways, Ltd., Knott Mill Ironworks, Manchester. Mark envelope "Expert." 1997 A

WANTED, First-class MACHINERY ERECTOR, used to the Erection of Heavy and Light Machinery, Conveyors, Elevators, &c., only men of good practical experience considered.—Apply, stating experience and age, to B. A. C., c.o. Baker Perkins, Westwood Works, Peterborough. 1964 A

WANTED to Sail in September for a First-class Structural and Bridge-building Works in India, a qualified ASSISTANT WORKS MANAGER, age about 30; salary to commence at equivalent of approximately £750 a year, with excellent prospects of advancement; must have had previous experience in similar capacity. Agreement for 5 years.—Apply with copy of photograph and full particulars to ZZ 301, care Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 1992 A

ASSISTANT TO CHIEF ENGINEER for Combustion and Boiler-house Detail Work REQUIRED for Power-house, London district. Applicant should have had college training and five years' practical experience. State experience.—Address, 1953, The Engineer Office. 1953 A

ASSISTANT WORKS MANAGER WANTED for Hong Kong, age 27-30, with good technical and practical training in Marine Engine Construction. Liberal salary will be paid to a man with the necessary qualifications. State age and full details of experience.—Address, "EAST," Wm. Porteous and Co., Advertising Agents, Glasgow. P5845 A

CIVIL ENGINEER, with Experience as Contractor's Agent REQUIRED for England; must be qualified Engineer, with extensive experience in Piling, Deep Excavations, Cofferdams, in tidal waters. Applicants should state age, qualifications, practical experience, references and salary required.—Address, 1951, The Engineer Office. 1951 A

CHEMICAL ENGINEER WANTED for a Large undertaking; should be over thirty, under fifty. Must be thoroughly experienced as Designer and have some experience in Operating Chemical Plant such as Heavy Chemicals, Gas Products, Metallurgical Plants. Good salary.—Write personal details and fully as to training and experience, to "PROCESS," care of Dawsons, 118, Cannon-street, London, E.C. 4. 1985 A

A LARGE Engineering Firm in London REQUIRES the SERVICES of a CHIEF RATEFIXER. Applicants must be fully experienced in all branches of Ratefixing for the highest class Automobile Production; capable of Taking Charge of the Ratefixing Department and have held a similar position previously.—Address, giving full details of experience, qualifications, age and salary required, 1958, The Engineer Office. 1958 A

SITUATIONS OPEN (continued)

ELECTRICAL ASSISTANT to CHIEF ENGINEER for Power-house in London district; applicant should have had college training, B.Sc. degree, and ten years' experience with H.T. supply. State experience in confidence. Salary £600.—Address, 1952, The Engineer Office. 1952 A

ELECTRICAL ENGINEER, with Degree or Equivalent, at least three years' works experience, and familiar with Light Current and Valve Amplifier Work, REQUIRED for Experimental Work.—Applications should be tabulated and give full particulars of work done and certificates obtained, with dates, age, and salary required, to Box E247, c.o. C. Mitchell and Co., 1, Snow-hill, E.C. 1. 1987 A

INDIA.—A BRITISH FIRM with Works in India REQUIRE a WORKS MANAGER with Structural and Mechanical Engineering experience. Must have initiative and organising ability, office and works experience. Age 28 to 35; bachelor preferred.—Reply, stating age, training, salary required, to "Z.O. 272," c/o Deacon's Advertising Agency, Fenchurch-avenue, London. 1913 A

LONDON REPRESENTATIVE.
An old-established Company manufacturing High-class Weighing Machinery and Testing Machinery invites APPLICATIONS from men with the necessary technical knowledge and experience for the POSITION of LONDON SALES REPRESENTATIVE.—Address, with fullest particulars as to experience and salary which will be treated in strict confidence, 1919, The Engineer Office. 1919 A

PRIVATE SECRETARY (Man) REQUIRED by Engineers in Westminster; good general education and rapid Shorthand Typewriting essential; must be prepared undertake temporary visits abroad.—Address, stating age, experience, salary required, and giving two references, 1999, The Engineer Office. 1999 A

PRODUCTION MAN REQUIRED for Control Department.—Address, 2004, The Engineer Office. 2004 A

REQUIRED for British-owned Railway in Argentine, YOUNG ENGINEERS for Service in the Locomotive, Carriage, Wagon and Vehicle Department; must have served regular apprenticeship on railway, and have had a year or more of practical Railway Experience. Commencing salary about £450 p.a. on 3 years' agreement.—Reply, stating age, if single or married, and giving full details of education, training and experience, with copies (only) of testimonials, to Box L. G., c.o. Davies and Co., 95, Bishopsgate, E.C. 2. 1962 A

SENIOR REINFORCED CONCRETE DESIGNER REQUIRED; must have previous specialist experience.—Address, giving full particulars of training and experience, with dates and salary required, 1995, The Engineer Office. 1995 A

STEELWORK DESIGNER REQUIRED by Constructional Engineers in London; permanent post to right man. Similar experience essential. Give full particulars of same, also age and salary required, &c.—Address, 1996, The Engineer Office. 1996 A

THE CHATWOOD SAFE CO., Ltd., Harlescott, Shrewsbury, REQUIRE a PRODUCTION ENGINEER with a thorough knowledge of producing interchangeable components for small repetition work.

Modern house with electric light available.

Applicants must give full details of their training, actual experience, and salary required.

Address to the TECHNICAL DIRECTOR. 1915 A

TOOL-ROOM.—WANTED IMMEDIATELY, Capable and experienced TOOL DESIGNER; able to Take Entire Charge of Draughtsmen and Tool Makers, large engineering works in London district.—Address immediately, stating age, experience and salary required, 1969, The Engineer Office. 1969 A

WATER SOFTENER MANUFACTURERS REQUIRE ENGINEER, age 30-40, for Supervising Erections and Starting-up Plants.—Write, stating past experience, salary required, to Box 704, Sells, Fleet-street, E.C. 4. 1988 A

YOUNG Fully Qualified CIVIL ENGINEER, Preferably with some experience with Engines and Boilers; commencing salary £350 p.a.—Address, giving age, full experience and with copies of two testimonials, to SECRETARY, Trent Navigation Co., Wilford-road, Nottingham. 1994 A

YOUNG MEN with Electrical and Mechanical Designing experience to train as designers of small Electrical Instruments. Preference given to those with sound technical training; good opportunity. South London district.—Address in confidence, 1905, The Engineer Office. 1905 A

YOUNG TRAINED ENGINEER REQUIRED as Assistant to Works Manager of a Paint Factory in East London. He will be required to Supervise the Plant, Machinery and Building. Candidates, who should be about 23 years of age when applying, must give fullest particulars of experience, &c., to Box Z.Y. 300, c.o. Deacon's, Fenchurch-avenue, E.C. 3. 1993 A

WANTED, DRAUGHTSMEN (One Senior and One Improver), with good all-round experience of Automobile and similar work for Ball Bearing Manufacturers. State full experience, salary required and when available.—Address, 2002, The Engineer Office. 2002 A

WANTED, DRAUGHTSMEN (Seniors and Juniors), for Electrical Crane Work; splendid opportunity for good men with ambition. State full experience, age and salary required.—Address, 1998, The Engineer Office. 1998 A

WANTED in London District, ONE or TWO DRAUGHTSMEN, about 30 years of age, experienced in Constructional Steelwork Design and Details.—Address, stating salary and experience, 1955, The Engineer Office. 1955 A

WANTED, JIG and TOOL DRAUGHTSMAN, with experience on Special Machine Design. Also IMPROVER for Jig and Tool Work. East Midlands district. State full experience, age, salary required and when at liberty.—Address, 2001, The Engineer Office. 2001 A

WANTED, JUNIOR DRAUGHTSMAN in London district, age 23 to 26. Experience in preparation general arrangements, layouts and details for High-speed Machinery. Workshop training. Permanency for suitable applicant.—Address, giving age, full particulars of training, experience, and salary required, 1932, The Engineer Office. 1932 A

DRAUGHTSMEN, Capable Young, REQUIRED for Aircraft Detail Design Work. Must be quick and accurate.—Write, giving age, experience, and salary required, to HANDLEY PAGE, Ltd., Cricklewood, N.W. 2. 1859 A

DRAUGHTSMAN-DESIGNERS WANTED for Press Tools, Auto. Tools, Jigs, and Special Machinery. Applicants preferably between 25 and 35 years of age.—Address, giving full details of experience, age, &c., 1977, The Engineer Office. 1977 A

DRAUGHTSMAN, JIG and TOOL. Senior Man for high production of Car Components. Good prospects for suitable applicant. Only first-class man considered.—Write, Box 542, Dorland, 14, Regent-street, S.W. 1. P5847 A

DRAUGHTSMAN, Mechanical, with A.C. or D.C. Motor Details experience preferred.—Address, stating age, experience, and salary required, 1943, The Engineer Office. 1943 A

DRAUGHTSMAN.—REQUIRED in London Office of Firm of Engineers, DRAUGHTSMAN with knowledge of Conveying and Mechanical Handling Plants. Experienced men only need apply. State age, salary, and experience.—Address, 1826, The Engineer Office. 1826 A

DRAUGHTSMAN, SENIOR, with First-class Experience of Steam Turbine Design and Details.—Apply, stating age, experience, and salary required, to MANAGER, Drawing-offices, B.T.H. Co., Ltd., Rugby. 1830 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED, with First-class Designing Ability, for Laundry Machinery. Permanent post offered to a suitable man who must have initiative. Previous knowledge of laundry machinery not essential, but desirable.—State age, salary required and full experience to Laundry Dept., BAKER PERKINS, Peterborough. 1965 A

DRAUGHTSMEN WANTED, with Several Years' recent experience in the design of Heavy Passenger-carrying Motor Vehicles and Lorries.—Address by letter, giving full particulars of experience, age, and salary required, 1847, The Engineer Office. 8471 A

DRAUGHTSMAN WANTED, Used to Motor Vehicles, by West London firm.—Address, stating experience, age, salary, &c., 1978, The Engineer Office. 1978 A

DRAUGHTSMAN WANTED, Used to General Structural Steelwork; must be neat and accurate and capable of working with only nominal supervision.—Address, with full details, 2000, The Engineer Office. 2000 A

DRAUGHTSMAN, with Experience of Motor Accessory and Instrument Work; good prospects and permanency. State experience, salary required.—Box 4586, Woodwright Service, 150, New Bond-street, W. 1. 2003 A

ESTIMATING DRAUGHTSMAN, Experienced Structural Steelwork for factories, age 25-27, unmarried. Four years' engagement, Ceylon.—Apply, writing, WALKERS, 3, London Wall-buildings, E.C. 2. P5848 A

FIRST-CLASS DRAUGHTSMAN WANTED for large Textile Concern in Glasgow; Power Plant and good general engineering experience essential; some experience in Textile Machinery Arrangements desirable. B.Sc. preferred; age 30 to 35. Give particulars of training and experience; good salary to right man.—Address, 2005, The Engineer Office. 2005 A

MECHANICAL DRAUGHTSMAN (JUNIOR) WANTED, preferably some experience of perspective, by Chartered Patent Agents; knowledge of Technical Subjects useful.—Write, PAGE, WHITE and VAUGHAN, 27, Chancery-lane, W.C. 2. 1974 A

JUNIOR DRAUGHTSMAN WANTED. Preference will be given to a man who has had good workshop experience in general engineering works. State age, references, salary.—Address, 1953, The Engineer Office. 1953 A

STEEL WORKS DRAUGHTSMAN REQUIRED, Sheffield district. Must be fully experienced.—Address, giving full particulars, age, and salary expected. 1901, The Engineer Office. 1901 A

REQUIRED by Steel Railway Wagon Builders in India, FOREMAN. Age not over 30. Must have held similar position in this country.—Reply, fully stating age, education, training, present work and wages or salary, to Z.T. 319, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 2008 A

SITUATIONS WANTED

A.M.I. MECH. E., with Wide Technical, Executive and administrative experience, shortly returning from the Near East, is OPEN to CONSIDER any RESPONSIBLE POST, technical or commercial, at home or abroad. Special experience in steel works and oil works practice.—Letters to Box C.R., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 1963 B

A.M.I. MECH. E., Age 34, 18 Years' Experience, works, foundry, D.O., works management. Extensive technical training. Excellent references. DESIRES APPOINTMENT, home or abroad.—Address, P5850, The Engineer Office. P5850 B

ENGINEER, Excellent Home and Continental Experience in design, manufacture, and use of general engineering machinery, pumping expert, centrifugal and turbo pump specialist, SEEKS RESPONSIBLE POSITION: first-class testimonials and references.—Address, P5842, The Engineer Office. P5842 B

ENGINEER, Fully Qualified Electrical and Mechanical, DESIRES WORK; lay-out of factories, development of ideas, and the design of labour-aiding machinery undertaken. Terms moderate.—Address, P5840, The Engineer Office. P5840 B

ENGINEER, Mechanical and Electrical, 25 Years' experience on design and erection of plant, five years chief engineer of large factory, DESIRES SIMILAR POST; excellent references.—Address, P5841, The Engineer Office. P5841 B

ENGINEER, with Commercial Experience, B.Sc. (Eng.) Lond., A.M. Inst. C.E. (30), specialised in crude oil engines, having successfully concluded contract in India, DESIRES RESPONSIBLE POSITION, home or Continent; accustomed complete control of preparing schemes, estimating and erecting power-houses, pumping stations and all industrial machinery.—Address, P5846, The Engineer Office. P5846 B

ENGINEER, Experienced in Crushing, Grinding, screening and pulverised fuel elevating and conveying machinery, OPEN TO ENGAGEMENT; can influence orders.—Address, P5844, The Engineer Office. P5844 B

ENGINEER (40) SEEKS POSITION. Superintendent or Chief, machine, fitting, toolmaking, inspection progress, rate fixing; 17 years' executive experience, references, and well recommended.—Address, P5849, The Engineer Office. P5849 B

SALES ENGINEER (32), Tech. Commercial Eight years, India, OPEN to ENGAGEMENT, preferably East.—E. G. BROWN, c/o 18, Reynolds-road, Old Trafford, Manchester. P5838 B

PARTNERSHIPS

BUSINESS MEN in NEED of FURTHER WORKING CAPITAL, and have no objection to a Private Ld. Co. (Mortgages, Propositions, and Patents entertained).—Write, RUSSELL ESTATES, Ltd., 88, 89, and 90, Chancery-lane, London, W.C. 2. P5839 C

AGENCIES

AGENTS WANTED in All Districts with Good connection to sell new patent material effecting great economy to steam boiler users. Substantial commission basis.—Address, 1946, The Engineer Office. 1946 D

EDDYSTONES LTD., Caxton House, S.W. 1, WISH to APPOINT AGENTS throughout the British Isles (with the exception of London) for the sale of a proved device for increasing the efficiency of fire-tube boilers. Applicants must be well established and have a sound knowledge of combustion. 1971 D

ENGINEER, Westminster, Conducting Old-established business with home and foreign railways and consulting engineers, DESIRES AGENCY for Railway Materials.—Address, P5833, The Engineer Office. P5833 D

EXPERIENCED REPRESENTATIVE (30), with connection railway companies, exporters and mining companies in London, SEEKS AGENCY for Engineering or Railway Materials.—Address, P5843, The Engineer Office. P5843 D

FIRM of COMBUSTION ENGINEERS REQUIRES AGENT (commission basis), to operate areas from Norwich, Huntingdon, Grantham, Oxford and Cardiff.

Applicants should have a connection among architects, heating engineers, and boiler users.

Address, 1735, The Engineer Office. 1735 D

For continuation of Small Advertisements see page 4.

A Seven-Day Journal

The "Rocket."

A FEW days ago we had the pleasure of seeing under steam the most remarkable reconstruction of an ancient engine that has ever been made. It was the "Rocket," built by Robert Stephenson and Co., Ltd., for Henry Ford, who will place it in his museum at Detroit. The order was to construct as far as possible an exact facsimile of the original as she took the rails at Rainhill but a few months less than a century ago. Faithful to that order the builders have used such materials as the Stephensons, father and son, had at their disposal, and as far as possible they have used the contemporary methods of construction. The boiler is of iron riveted together by hand, and the copy is so exact that the pitch of the riveting has been followed even where it was manifestly undesirable. Even the famous mercury pressure gauge beside the chimney has been fitted, though provision has been made for mounting a dial gauge of more modern type as well. In our next issue we shall have more to say about this wonderful "model," and here we only record that it was shown under steam to a small party of visitors yesterday, to others to-day, and that to-morrow, Saturday, it, with a couple of modern engines, will be run for the inspection of the public and the benefit of the Darlington General Hospital.

Rural Electrification.

IN our issue of April 12th reference was made to an experimental rural electrification scheme, designed to demonstrate the practicability of supplying electricity to villages and farming areas. The scheme is apparently beginning to take practical form, for an area of approximately 100 square miles lying to the north and west of Bedford has been selected by the Minister of Transport for the experiment. As the result of an application made by the Bedford Town Council to the Electricity Development Commissioners, the Treasury has agreed that for a period not exceeding ten years advances shall be made to the Council from the Development Fund. Sums not exceeding £8000 are to be advanced as may be required to meet 75 per cent. of the actual annual deficits on the working of the scheme, and the advances are to be repaid out of subsequent profits. In order that the progress of the scheme may be facilitated and its results closely watched the advice and assistance of the Electricity Commissioners and the Development Commissioners are to be placed at the disposal of the Bedford Corporation.

The Retirement of Sir John Pringle.

AFTER a connection of nearly twenty-nine years with, first, the Board of Trade and then with the Ministry of Transport as an Inspecting Officer of Railways—since July, 1916, as the Chief Inspecting Officer—Colonel Sir John Pringle retired yesterday, May 23rd. In the public mind Sir John's name is usually coupled with inquiries into the causes of railway accidents, but he and his two colleagues have other duties to perform which are of equal importance. The purpose for which the first Inspecting Officer—Sir Frederick Smith—was appointed in August, 1840, as a consequence of the Act of that year, was to see that before any railway was opened for public traffic it was safe. Accidents had, under the same Act, to be reported, and although no authority was given for such a procedure, they also were inquired into. Such inquiries were not, in fact, sanctioned until the further Act of 1871, under which the power to inspect new railways was also extended to new connections, new stations, &c. Tramways also had to be inspected and a good deal of work was thrust upon the department when tramways were converted from horse or steam operation to electric traction. Besides his inquiries into some of the more serious accidents of recent years, Sir John will be remembered for three things. The first and most important is the revision of the Requirements as to New Railways, which not only gave great assistance to the railway companies, but put upon record what was permitted and expected as to safety. The second is his chairmanship of the two Departmental Committees on Automatic Train Control. The third is a small matter but is worthy of record. It is the change in the character and style of the annual reports on railway accidents which Sir John adopted when he was made responsible for them in 1919.

The New Chief Inspecting Officer of Railways.

THE retirement of Sir John Pringle has led to Lieut.-Colonel A. H. L. Mount being promoted to the position of Chief Inspecting Officer. Colonel Mount, from the time he joined the Royal Engineers in 1902 until the outbreak of war, spent most of his time on railway construction work in India. Going to France in 1914 with the Lahore Division, he was soon engaged in the construction of military railways and by 1917 was appointed deputy chief construction engineer for broad-gauge railways under the Director-General for Transportation. His appointment as an Inspecting Officer of Railways under the Ministry of Transport dates from January 1st, 1920, and it is of interest to note that it fell to him to inquire into the three cases—East Hornden, Cheadle Hulme, and Furness Vale—in 1922 of broken connecting-rods on locomotives and into the failure of the City and South London tube at the Borough in November, 1923. The conduct of an accident inquiry needs several important qualifications. The Inspecting Officer is not only, in a sense, the judge and jury, but he has to be, using the same simile, counsel for the defence also. He must be fair to the men whose conduct he is judging and endeavour to see their point of view and, if possible, make allowance for their mentality or any disadvantages under which they labour. All concerned—the Ministry, the companies, and the men—are fortunate in the new Chief Inspecting Officer of Railways.

The A.E.U. and Local Action.

AT the annual meeting of the National Committee of the Amalgamated Engineering Union, held at Llandudno on Thursday of last week, May 16th, a resolution was moved and seconded to the effect that if the national application now before the employers for a wages advance of 8s. was not conceded a ballot vote should be taken for or against action to enforce an advance. The resolution was defeated by a vote of 38 to 14. Following the defeat of this proposal a second resolution was moved to the effect that if the national application were not conceded by August the Executive Committee should give the District Committees power to negotiate for wage increases with local employers. The Executive Committee expressed its opposition to local action, and on its behalf it was stated that if that issue were forced it was almost a certainty that the whole of the country would soon be involved in a struggle. The employers, it is already well known, are entirely opposed to local negotiations, and any attempt on the part of the Union to insist upon local action would probably result in a national lockout being declared. The General Secretary to the Union warned the Committee that the Union was not in a financial position to face a lockout of the whole membership. An amendment to the second resolution was moved instructing the Executive Committee to continue the negotiations on a national basis. This amendment was carried by 31 votes to 21.

New Ford Motor Works.

ON Thursday of last week, May 16th, Mr. E. B. Ford, son of the founder of the well-known American motor car firm, cut the first sod on the site of a new Ford motor works at Dagenham, Essex. The erection and equipment of the works will, it is estimated, involve an expenditure of about £5,000,000 and will occupy a period of about three years, during which between 2000 and 3000 men will be employed. When finished the works will cover an area of nearly 300 acres and will occupy second place only to the parent firm's Detroit establishment. Employment for 15,000 workpeople will be found at the works when they are in full production, and it is intimated that the wages paid will be comparable with those received by the workers in the American establishment. The Dagenham factory is being planned to supply the whole of Europe with the Ford Company's products and will, it is estimated, require to turn out 150,000 cars a year to satisfy the export trade alone. The company's existing works at Old Trafford, Manchester, are, it is stated, to be maintained as an assembling and distributing centre for the North. A feature of the Dagenham scheme will be the generation of all the electrical power required to operate the plant from the South Hornchurch refuse dump. Surplus electricity will be offered to the public at a low rate. About 3400 new houses are to be erected in the neighbourhood of the works by the London County Council, the local Council, and private enterprise.

The Port of Singapore.

ON Tuesday last, May 21st, the report of the Imperial Shipping Committee on the improvement and development of the harbour of Singapore was issued as a White Paper. In response to an invitation by the Secretary for the Colonies, the Committee, under the chairmanship of Sir Halford Mackinder, has considered a report on wharf extension by Mr. G. W. A. Trimmer, the chairman, manager and chief engineer of the Singapore Harbour Board, along with a report by the consulting engineers, Messrs. Coode Fitzmaurice, Wilson and Mitchell, of Westminster. It has also consulted masters of merchant ships, shipping companies, and Admiralty authorities. The Committee's report emphasises the necessity of treating Singapore mainly as a transshipment port. In its recommendations, it suggests that any material increases in the port charges which might be brought about by new schemes of extension should be avoided. A new line of deep-water wharves, it considers necessary, although the whole of this work need not be undertaken at once. No change, it suggests, should be made in the coaling arrangements, until experience indicates the effect on the demand for bunker coal of the extended use of oil fuel and pulverised coal. With regard to the removal of hindrances to navigation, it is proposed that the cost of removing the Tembaga Shoal and Reef to a depth of 33ft. should be at once ascertained; also that of removing the whole of the Maender Shoal. If such cost should prove to be excessive, modified proposals may be adopted. It is also suggested by the Committee that the lights at the harbour approaches should be considered by a competent authority, and that the provision of additional and improved lights should be carefully taken into account. In the opinion of the Committee, no additional dry docks should be constructed at present.

Foreign Naval Contracts.

IN competition with British, French, and American firms the Italian shipbuilding industry has booked an important naval contract from the Turkish Government. It comprises two destroyers, two submarines, and several "scouts"—presumably small patrol craft—all of which are to be delivered within twenty-two months. The contract, which is distributed among two or more Italian yards, is worth £T15,000,000, but payment is to be spread over eight years, and it is admitted that the margin of profit will be a slender one. In view of this order it is interesting to review the foreign naval contracts placed since the war. British yards have built six destroyers and three submarines for Chile, three flotilla leaders and two surveying ships for the Argentine, two submarines for Jugo-Slavia, and a gunboat for Siam. French firms have constructed six submarines for Greece, two destroyers and three submarines for Poland, and two submarines for Jugo-Slavia. Besides the Turkish contract just secured, Italy has built two 6800-ton cruisers and three submarines for the Argentine, two destroyers, one submarine, and a submarine depôt ship for Roumania, and one submarine for Brazil. The United States has built six submarines for Peru. In this branch of business British yards have, on the whole, held their own, but Italy has proved herself a formidable rival, on the score both of good workmanship and readiness to accept financial terms of a not very attractive character.

A Proposed National Water Commission.

AT the annual meeting of the Institution of Water Engineers which was held in Birmingham on Wednesday last, May 22nd, Mr. W. F. Macaulay, in the course of his presidential address, made reference to the need for a national body, which would be capable of dealing with all questions relating to water supply and control, and of giving disinterested and technical advice when such was needed. He said that he considered it of the greatest importance that there should be the completest possible survey of all water questions. Information so obtained would be of the greatest importance in conserving and allocating water supplies, and in restoring and preserving the purity of our national water resources. Such a survey would, he thought, involve the creation, if not of a statutory water commission, some form of national body which could carry out the duties outlined. Mr. Macaulay said, further, that it was perhaps not necessary to warn those present that such a survey as that proposed must not be looked upon solely from the point of view of domestic supplies. There were other forms of activity which called for a greater knowledge of our water resources. That need was already recognised, for instance, in the matter of the proper dilution of sewage effluents.

The Airship Graf Zeppelin.

AT 6 o'clock on the morning of Thursday, May 16th, the German airship "Graf Zeppelin," carrying a crew of forty, eighteen passengers and two and a half tons of freight, left Friedrichshafen on what was intended to be her second voyage across the Atlantic to Lakehurst. At half-past two on the afternoon of the day of her departure she was reported over Barcelona, but some time later, when over Saragossa, two of her motors failed, and it was decided to head the vessel back to Germany. While flying over the Rhône Valley the vessel was farther crippled by the failure within five minutes of each other of two more of her engines. In the face of a wind which at times reached a velocity of nearly forty miles an hour the airship struggled along with but one engine at work. At 8.45 p.m. on Friday, May 17th, the attempt to return to Germany having proved vain, she was landed with great skill at Cuers, near Toulon, and safely housed in a shed formerly used by the French airship "Dixmude." It is not yet clear in what respect the engines failed. According to one account, all four went out of action by reason of the fracturing of their crank shafts, but there is some uncertainty as to whether the second pair suffered such a serious mishap. Dr. Eckener, the designer and navigator of the vessel, is reported to have stated that the failures were directly attributable to improvements made in the Maybach engines with which the airship made her first voyage across the Atlantic. These improvements, consisting, we believe, in fitting the engines with superchargers, had been tested on flights made by the airship to Vienna and across the Mediterranean. That the engines subsequently failed strongly suggests fatigue resulting from torsional vibration as the cause. Maybach engines of the original pattern are to be restored and the vessel, it is hoped, will shortly again essay the Atlantic passage.

The Shannon Power Scheme.

No. V.*

As stated in a previous article, the pressure at Ardnacrusha is to be stepped up to 110 and 38·5 kV—or, to put it shortly for simplicity's sake, 38-kV—and at these pressures the power will be distributed over the whole of the Irish Free State by means of high-tension transmission lines. The map—Fig. 38—shows the lay-out of the 110 and 38-kV lines and the positions of the 110/38-kV and 38/10-kV transformer stations for the partial development scheme. The 110-kV lines form the primary transmission system and a six-conductor, 110-kV line will run from Ardnacrusha to Dublin, a distance of 116 miles, whilst a three-conductor 110-kV line will run from Ardnacrusha to Cork to connect the two 110/38-kV main transformer stations in these two cities with the main power station. The 38-kV transmission system is planned to give loop distribution. The total length of the 38-kV lines, when completed, will be about 1040 miles, and the four loops into which the system is divided are:—Loop (I.) Ardnacrusha, Waterford, Cork, Mallow, Tralee, Killarney, Ardnacrusha. Loop (II.), Ardnacrusha, Ennis, Galway, Swinford, Boyle, Mohill, Athlone, Maryboro', Ardnacrusha. Loop (III.), Mohill, Cavan, Ardee, Ashbourne, Dublin. Loop (IV.), Dublin, Wexford, Waterford, Carlow, Maryboro', Dublin.

The 38-kV system will have, at the outset, three main feeding centres—Ardnacrusha, Dublin and Cork. Later, the 38/10-kV transformer station at Maryboro' will be converted to a 110/38/10-kV station, thus forming a fourth main feeding centre for the 38-kV system. In the various 38/10-kV transformer stations connected up with the 38-kV lines the electrical energy will be transformed down to 10-kV, and these stations feed a distribution system of 10-kV lines. The 10-kV overhead system will serve for local distribution and will convey current to the 10,000 volt transformer stations of the cities, towns and villages. In these stations the energy will be transformed to low-tension energy at 380 and 220 volts, at which pressures the consumers will be supplied. The 110-kV lines are carried entirely on lattice steel masts, while the 38-kV lines are on lattice steel masts in the southern areas and on wooden poles in the northern areas. For the 10-kV lines, wooden poles are being employed exclusively. All the transmission lines are being constructed according to specifications issued by the Chief Electrical Engineer for the Government, which take into account the special conditions peculiar to Ireland and are in some cases more exacting than in other countries.

We shall now describe the construction of the 110-kV and 38-kV lines on steel masts, leaving an account of the lines on wooden poles for a later article. As already mentioned, the 110-kV line running from Ardnacrusha to Dublin is constructed as a six-conductor line and the 110-kV line from Ardnacrusha to Cork as a three-conductor line. Except in a few special cases where two lines approach each other closely, the 38-kV lines are constructed as three-conductor lines. The two double lines are suspended on a special pole construction calculated to carry six conductors. Examples of some of the transmission lines are given in Figs. 39 to 43. In almost all cases the conductors are composed of hard-drawn copper, having an ultimate tensile strength of over 40 kilos. per square millimetre. For the 110-kV lines the cross-sectional area of the copper is 95 square millimetres and 50 square millimetres for the 38-kV lines. The 95 square millimetre cable is composed of nineteen single wires, the diameter of each wire being 2·5 mm., while the 50 mm. cable has nineteen single wires, with a diameter of 1·8 mm. The conductors are strained so that at a temperature of — 5 deg. Cent., and with an additional load of 180 $\sqrt{d}$ grammes per metre length of conductor, or at 20 deg. Cent. without additional load, the stress does not exceed 19 kilos. per square millimetre, Bronze conductors are only used on the 38-kV lines under exceptional circumstances, as, for example, where their employment is necessitated by the profile of the ground, where a deep valley has to be crossed by the lines, or where an abnormally long span occurs. In such cases the bronze conductors have a cross section of 95 square millimetres, the cable being stranded with thirty-seven single wires. As these bronze conductors have an ultimate strength of 70 kilos. per square millimetre, the sag is less than with copper conductors, while the same factor of safety is maintained.

On the 110-kV and 38-kV lines the conductors are supported by porcelain insulator chains composed of seven and two insulators respectively. They are designed for a dry flash over at 150 kV per pair of insulators or at 450 kV per seven insulators, and for a wet flashover at 123 kV per pair of insulators or 338 kV per seven insulators. Where greater security is required, as, for instance, where a line runs over a public road, an additional insulator is placed in the suspension or strain chains, whilst at points where still greater mechanical security is needed, as

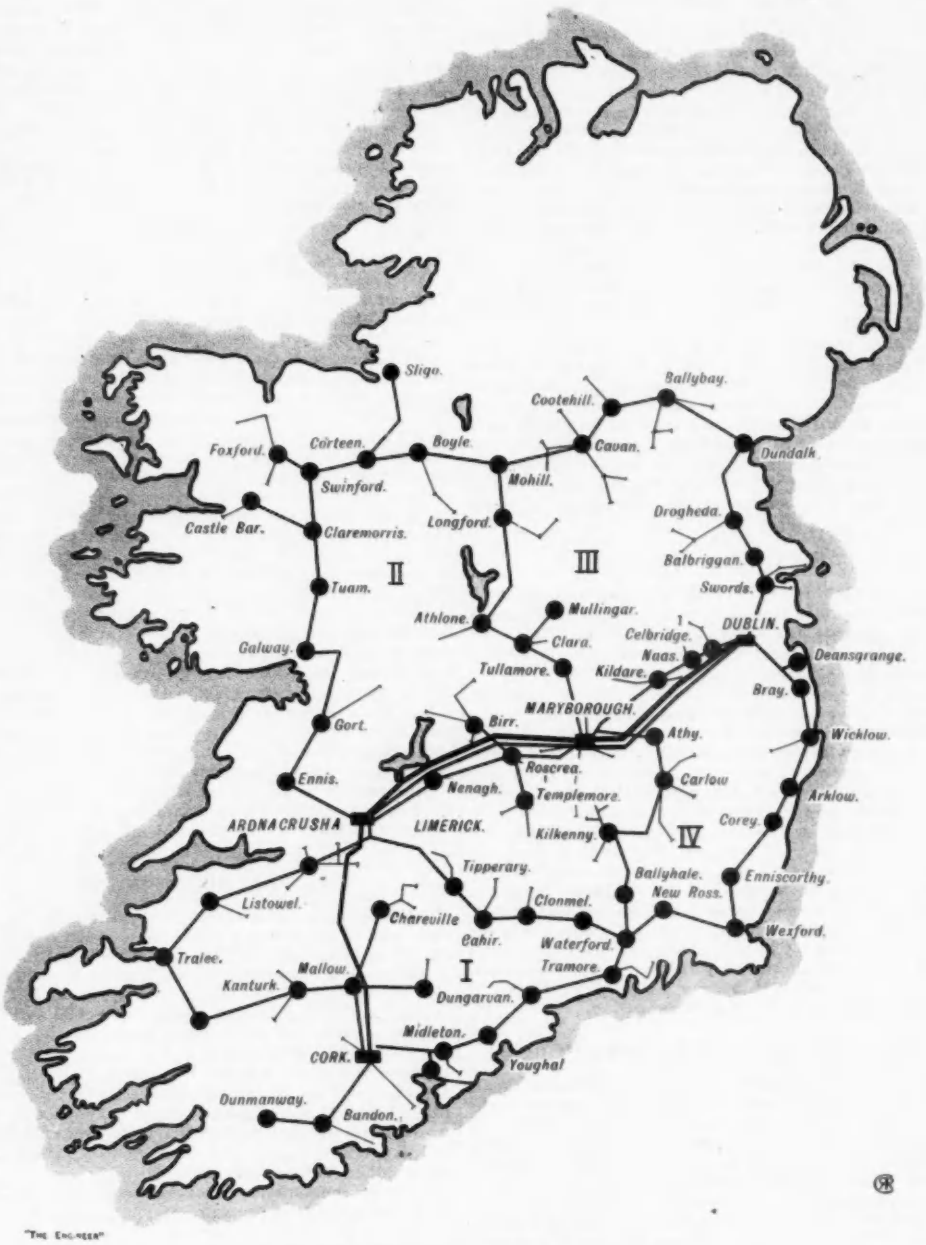


FIG. 38—MAP OF TRANSMISSION LINES AND SUB-STATIONS

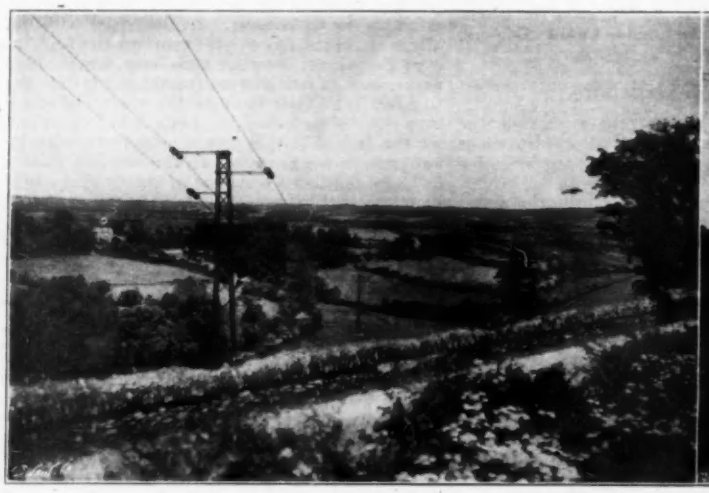


FIG. 39—STRAIN POLE ON 38·5-kV LINE

FIG. 40—RAILWAY CROSSING NEAR NAAS

* No. IV. appeared May 17th.

when crossing railways, navigable rivers, canals or communication lines, double chains, each composed of eight insulators, are utilised for the 110-kV line, and

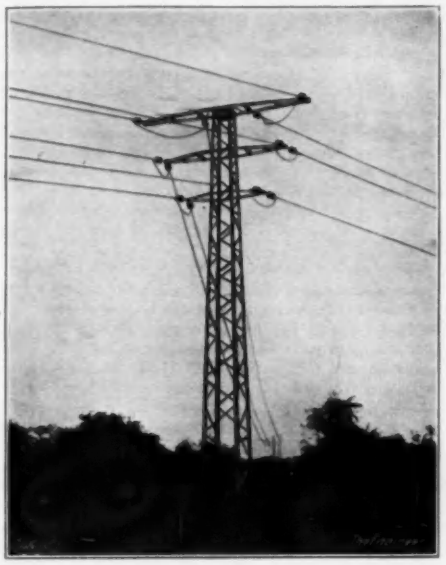


FIG. 41—38-kV BRANCHING POLE NEAR MARYBOROUGH

double chains, each composed of three insulators, for suspension as well as for the strain chains in the 38-kV lines. Fig. 44 shows a strain insulator

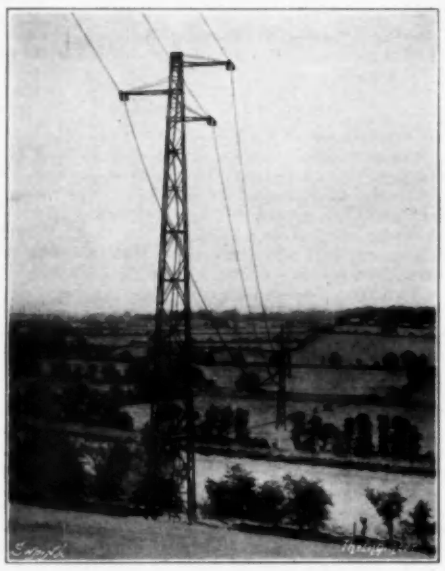


FIG. 42—38-kV RIVER CROSSING

chain for 38-kV lines, Fig. 45 a suspension insulator chain for 110 kV lines, Fig. 46 the parts of, and Fig. 47 a section through a "V" ring insulator.

clamps are fitted with a copper inset thimble, which protects the copper cable, as shown in Fig. 48. Joints in the conductors are made by means of grooved connectors which combine great mechanical strength with low electrical contact resistance, and as the breaking strength for the 95 square millimetre cable copper connector is 3770 kilos. and that for the 50 square millimetre copper cable connector 2010 kilos., the strength of the connectors and that of the cables may

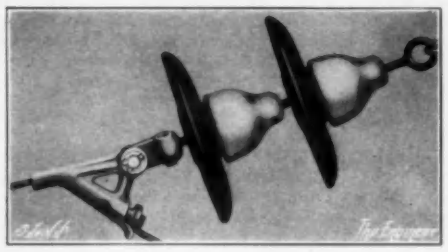


FIG. 44—STRAIN INSULATOR CHAIN FOR 38-kV LINES

be said to be practically equal. The connection, before use and in position, is illustrated in Figs. 50 and 51 respectively.

For the 110-kV transmission lines a maximum span of 250 m. has been selected as the most economical, and for the 38-kV lines a span of approximately 200 m. For the 110-kV lines and the 38-kV steel poles lines the minimum clearances between ground level and the lowest point of the conductors prescribed,

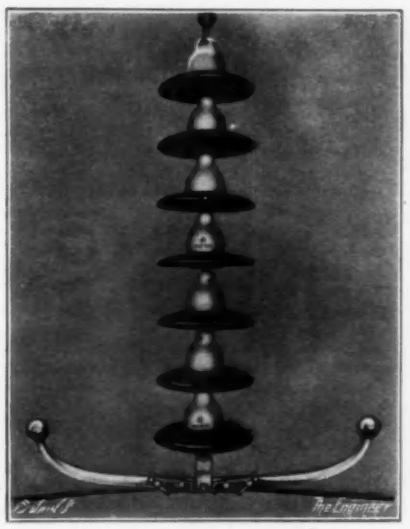


FIG. 45—SUSPENSION INSULATOR CHAIN FOR 110-kV LINES

in the interests of public safety, are 7 m. and 6·5 m. respectively. The lowest point of the conductors in spans crossing public roads is 7 m. above the road level. These conditions, taken in conjunction with the maximum sag of the conductors, determine the requisite heights of the poles.

As a rule the poles are mounted on wooden sleepers and fixed by channel irons on the pole base, see Fig. 52, which shows a 100-kV intermediate pole in the course

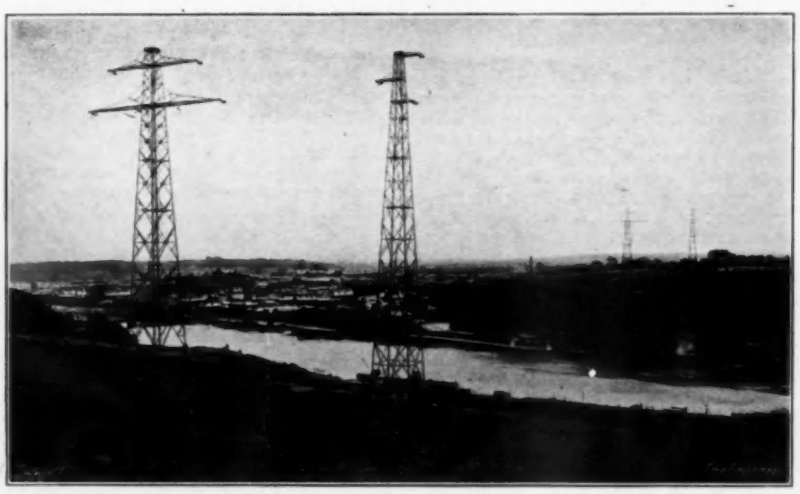


FIG. 43—POLES FOR 100 AND 38-kV RIVER CROSSING NEAR WATERFORD

For fixing the conductors to the insulators standard gun-metal suspension and wedge strain clamps are adopted, as shown in Figs. 48 and 49. The suspension

of erection. The sleepers are impregnated with creosote. The iron parts underground and for about half a metre above ground are treated with asphalt tar. The cross sections of all the lattice steel poles are square, and a normal 38-kV line pole stands 14·5 m. above the ground, but in special cases, where the profile of the ground is very uneven, intermediate poles, having an increased height of 2 m.

FIG. 46—PARTS OF "V" RING INSULATOR

and 4·5 m., are used. The crossarms are so arranged that no two conductors lie in the same vertical plane. A normal pole of a 110-kV six-conductor line stands 20·7 m. above the ground, and is provided

FIG. 47—CROSS SECTION OF "V" RING INSULATOR

with six sleepers, each 2·6 m. long; while the mast used for the 110-kV three-conductor line has a height of 18·2 m. above the ground. Special intermediate poles with an increased height of 2 m., are also employed

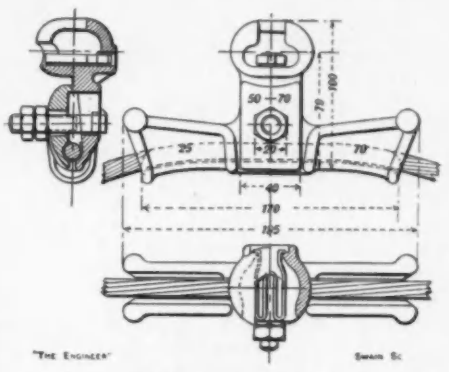


FIG. 48—SUSPENSION CLAMP

on the 110-kV lines where the profile of the ground necessitates their use. All portions of the steel poles from about half a metre above ground receive a primary coating of red oxide before leaving the steel

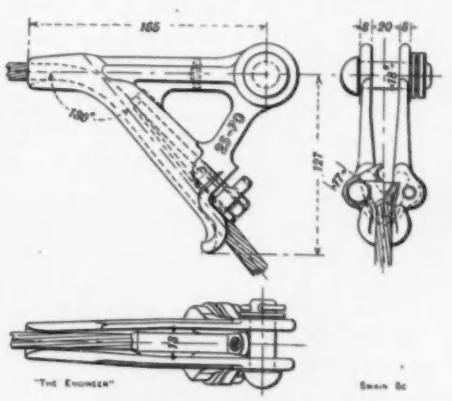


FIG. 49—WEDGE STRAIN CLAMP

works, and to preserve the steel from the deteriorating influences of adverse climatic conditions and changes of temperature, the poles are treated, after erection, with two coats of special anti-corrosive paint. The pole cross arms of the single three-phase lines are galvanised by the hot process. At intervals of not more

than 3000 m. strain poles specially designed to support two-thirds of the greatest tension on one side of the pole are used, and generally speaking, these spaces are further subdivided by crossing or angle poles.

Crossings over railways, communication lines,

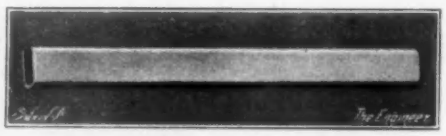


FIG. 50—NOTCH CONNECTOR BEFORE USE

canals, roads or navigable waterways are constructed with the shortest possible spans between the crossing poles. The minimum clearance between the power and communication lines is 1·83 m. on the 38-kV

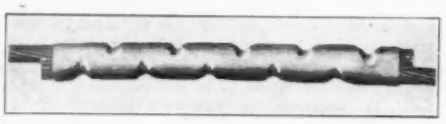


FIG. 51—NOTCH CONNECTOR IN POSITION

lines and 2·75 m. on the 110-kV lines. The distance between the lowest point of the conductors and a railway level is 7 m. on the 110-kV and 38-kV lines, whilst the minimum clearance between the power

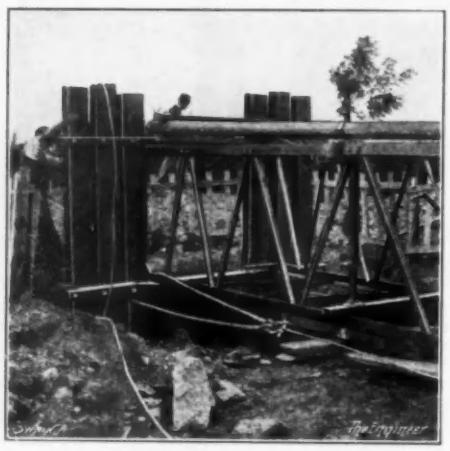


FIG. 52—FOUNDATION STRUCTURE

lines and waterways complies with the regulations of the river and canal authorities. Over ordinary canals there is a clearance of 7 m., whilst over the river Suir, a navigable river near Waterford, there

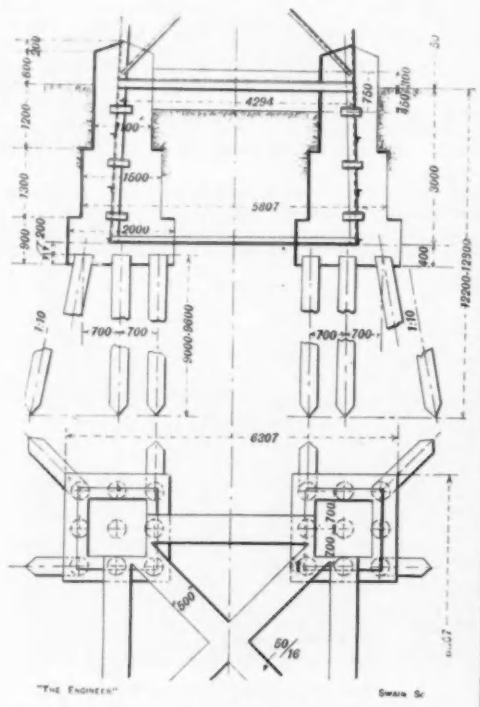


FIG. 53—FOUNDATION OF CROSSING POLE AT NEW ROSS

is a clearance of 45·7 m. The factor of safety for crossing poles and their foundations is the same as for ordinary poles. The factor of safety in the conductors of a crossing span is 5. Normal crossing poles are of the same height as the strain poles on the corresponding lines. For extra long spans, poles having a height up to 50 m. above ground level have been used, as in the case of the 38-kV crossing over the river Suir at Waterford—see Fig. 43—where these is a span of 470 m., necessitating the use of crossing poles 45 m. above ground level. There is an interesting crossing over the river Barrow at New Ross, where two spans exist, one over the river having a length of 373 m., the other a railway, this span being 250 m. long. The bronze conductors, of 95 square millimetres cross section, are strained on two crossing poles and suspended by double chains of suspension insulators from a central crossing pole, which stands in boggy and swampy ground. The bearing foundation is constructed on thirty-six large wooden piles—see Fig. 53—driven into the ground to a depth of about 12·5 m., the average upper diameter of the piles being 35 cm. Crossings between 110-kV lines and 38-kV lines, which are being constructed in the same manner as railway crossings, are also worthy of note. The 110-kV conductors pass over the 38-kV conductors with the prescribed minimum clearance of 5 m. between the lowest point of the 110-kV conductors and the highest point of the 38-kV conductors. In fulfilment of this condition, poles near Athy, for instance, on the 110-kV Dublin–Limerick line, crossing the 38-kV line, have a height of 28 m. above ground, and are mounted on wooden sleepers.

(To be continued.)

German Waterworks in 1928.

By H. STRINGER, Shanghai Waterworks.

THE water supply of Shanghai is taken from the Huangpu River, which has an average turbidity of 223 pts. per million, and an average bacterial content of 80,635 per c.c. at 20 deg. Cent. and 50,072 per c.c. at 37 deg. Cent. Shanghai is, therefore, in the unenviable position of possessing one of the most turbid, and probably the most polluted, sources of water supply in the world.

The demand for water supply has increased phenomenally. In 1907 the per capita consumption stood at 13 gallons per head, and it stands to-day at 29 gallons per head on a population of approximately 900,000. Maximum hourly demand, which, of course, controls capital expenditure, was, in 1928, 2,970,000 gallons, and is estimated to increase at a yearly rate of at least 150,000 gallons per hour.

The standard of purification demanded is the production of a water rather purer than that supplied by the Metropolitan Water Board and the U.S.A. Interstate standard. It is thus obvious that the Shanghai Waterworks, in order to cope with its great rate of expansion and complicated problems of purification, needs to be kept abreast of all that is most modern in purification and pumping practice.

American practice has been fully studied and profited by, but little was known of continental waterworks methods. To meet a desire for such information Germany was selected for an inspection in the summer of 1928. This inspection was extremely interesting from a general waterworks point of view. But at the outset it may be said that this tour was disappointing from a purification point of view as regards new ideas. This implies no reflection on German methods, it merely indicates that German problems are not Shanghai's, for the following reasons :—

The whole of Northern Germany, east of the Rhine, is a vast plain of water-logged sand, the rest level of this area being from 7 m. to 8 m. (23ft. to 26ft.) below ground. This, therefore, presents an inexhaustible source of supply, the water being apparently sterile at a depth of 20 m. to 30 m. (say, 66ft. to 100ft.), if the collecting area chosen is rural or suburban. The natural result, on account of its obvious economy, has been the development of methods of water supply which utilise this source.

The method used for the raising of this sub-surface water is known as the Hof system, and consists of a large horizontal main at a depth of about 15 m. (say, 50ft.) into which vertical collecting pipes of a diameter of about 150 mm. (say, 6in.) are tapped, running down to the selected sterile water-bearing strata. These small pipes are fixed at from 10 m. to 20 m. (say, 33ft. to 66ft.) centres, and are of copper, slotted for a length of at least 10ft. They are lowered into lined holes bored on the auger principle. The collecting main—housed in a tunnel—runs into a sealed well, whence it is pumped to filters, if these are necessary, thence to a reservoir and so re-pumped to the supply mains. The water from this source being sterile, filtration treatment is only necessary to eliminate the chemical impurities Fe and Mn. Aeration is adopted for oxidation purposes, and subsequent filtration over slow sand beds is usual, though I found the rapid-filter method installed in the Charlottenburg plant in Berlin.

It will, therefore, be seen that conditions have not been favourable for the utilisation of river supply ; in fact, in the case of both Berlin and Hamburg, where the rivers are used, there is an increasing tendency to develop sub-surface sources of supply at the expense of river water. As a natural consequence, the development of filtration methods has not received very great attention.

The effect on pumping design of the adoption of the Hof system has been to develop the vertical plunger type pump for lifting the water into reservoirs, whence it is pumped into the pressure mains by a similar type of pump, or, in the most recent work, by centrifugal pumps, either electric or Diesel driven. As opposed to British, modern German main-pumping practice evidently leans to the centrifugal pump with turbine or oil drive.* In support of this opinion, the report of the Hamburg Waterworks Engineer specially refers to the enormous saving in space as a result of the adoption of a turbine drive, and the saving in *personnel* at the Wallensee pumping station at Berlin, where steam plant has been entirely dispensed with in favour of oil and electric drive, was particularly impressive.

With regard to modern German boiler practice, boilers of the Babcock type are now universal with pressures ranging from 13 up to 30 atmospheres (say, 190 lb. to 440 lb. per square inch). They are equipped with chain grate stokers, automatic coal feed, overhead bunkers and conveyors. Recording instruments for steam and flue gas temperatures, CO_2, CO and H, and draught, which are intelligible to ordinary firemen, are to be found in every boiler-room. Buildings are everywhere extremely spacious, and allow for very large development. Engine-houses are tiled and beautifully kept, and the precincts of all works well cared for.

There is a curious vagueness about the maximum hour, which can only be deduced from an equally vague figure as to reserve. Waste detection receives no attention, for the obviously inadequate reason that metering is universal throughout Germany. There is no visible waste-prevention staff, owing to the same cause. The high per capita consumption, in spite of general metering, is to be observed, but Berlin in particular has a very hot dry summer. In every case examined pressures were sufficient to reach the highest buildings. Practice as to standby supply varies, as well as that relating to private fire hydrants. Bacterial examination is only usual in cases of river supply, and chlorinators are rarely used for sub-surface water.

COLOGNE WATERWORKS.

The water supply here is sub-surface and the gathering ground is situated in suburban surroundings about 8 kiloms.—5 miles—from the centre of the city. The previously mentioned Hof water supply system is employed here, and in this case the horizontal collecting main, which is at a level of 13 m. (say, 42ft. 8in.) below ground, is of a diameter of 1100 mm. (43·3in.), and is 2000 m. (say, 6560ft.) in length. Two hundred 150 mm. (say, 5·9in.) supply pipes are tapped into this, these small pipes running into a sand bed at a depth of 28 m. (say, 92ft.) below ground. The collecting main, which is housed in a tunnel, runs into two wells in which the water rises to the rest level of about 7 m. (say, 23ft.), whence it is pumped by four vertical type compound steam pumps to a reservoir distant 5 kiloms. (3·1 miles) in the town where the main pumping station is. These four pumps are of varying ages, but similar in type, the oldest being put down twenty-three years ago. They are of 140 H.P., running at an average speed of 45 r.p.m.—maximum 60 for 30 min.—and pump against a total head of 2·7 m. (8·8ft.), 0·4 m. (1·31ft.) being suction head. The steam consumption was given to me as 22 lb. per I.H.P.-hour. Each pump has a capacity of 1550 cubic metres (341,000 gallons) per hour. Generally two pumps were in work. Four Lancashire type boilers working at a pressure of 10 kilos. per square centimetre (142 lb. per square inch) and with a superheat of 100 deg. Cent. is the boiler-house equipment at this station, the evaporative power per boiler being 2 cubic metres (say, 4400 lb.) per hour. Two boilers were in steam and this is usual. Boilers are hand fired ; baby car transport for coal ; no economiser. Thirty men in all are employed at this station.

Main Pumping Station.—Reservoir capacity 20,000 cubic metres (4,400,000 gallons). A chlorinator is in reserve at influent, but is never used. The pumping station pressure is 40 m. to 45 m. (say, 130ft. to 150ft.), and the plant comprises five horizontal compound pumps of 250 H.P. each, the particulars of which are as follows :—

Speed : 60 r.p.m.—minimum 25.
Stroke : 900 mm. (35·4in.).
Steam Consumption : 135,000 kilos. per twenty-four hours for four pumps (12·4 lb. steam per P.H.P.H.).
Cylinder Diameters : H.P., 480 mm. (say, 18·1in.) ; L.P., 800 mm. (say, 31·5in.).
Ring Steam Main : 150 mm. diameter (5·9in.).
Pump End : Four delivery chambers per pump, 1100 mm. (say, 3·60ft.) diameter ; nineteen valves per deck, 205 mm. diameter (say, 8in.).
Mains : Delivery, 450 mm. (say, 17·7in. diameter, all engines delivering into a gathering main of 1100 mm. (say, 43·3in.) running lengthways and inside the building so that it is always accessible.
Pump Capacity : Average 2400 cubic metres

* Mr. Stringer would appear to be unaware that high-speed centrifugal pumps are being increasingly employed in waterworks practice in this country—notably by the Metropolitan Water Board.—ED. THE E.

(528,000 gallons); maximum 3100 cubic metres (682,000 gallons); 38 gallons per stroke. Plunger diameter is thus deduced at about 1·3in. and ratio valve area to plunger area is 375 per cent. Plungers between pump chambers are totally enclosed with a split casing.

At the time of maximum hour all five engines were in use, this figure being thus deduced at a maximum of about 3,750,000 gallons. The only reserve at the station consists of three compound beam engines with a stroke of 3 m. (9ft. 10in.) and a capacity of 1100 cubic metres (242,000 gallons) per hour each pump. These beam engines were erected in 1880.

Boiler-house.—Six boilers, Babcock type, hopper feed from overhead conveyor fed bunkers, chain-grate type stoker.

Pressures: 12 atmospheres (176 lb. per square inch).

Superheat: 265 deg. to 300 deg. Cent. Steam temperature = 100 deg. superheat.

Flue Gas Temperatures: 100 deg. Cent. (212 deg. Fah.), indicating the presence of an economiser.* CO_2, 8 per cent.

Gauges, which are easily intelligible to firemen, are provided for CO_2, CO and H, flue gas temperatures, and for draught.

The population of Cologne is between 600,000 and 700,000, and the daily consumption is 37 gallons per head. The whole supply is metered, the meters being of the inferential type.

Wallensee Pumping Station, Berlin.

This is the biggest of the thirteen pumping stations supplying Greater Berlin. It is the only one partially employing river water, the source being a large lake which is fed by the river Spree. No previous arrangements had been made for a visit here, but I induced my guide to apply direct to the municipal authorities, who at once gave me permission to visit the works, which are situated about 20 kiloms. (12·4 miles) from the centre of the city. These works are designed to take care of a maximum daily demand of 270,000 cubic metres (59,400,000 gallons), or 48 per cent. of the 560,000 cubic metres (123,200,000 gallons) required for an estimated population of three million people. The lake water is very clear, no coagulent being necessary, filtration over slow sand beds sufficing. Chlorination is only used in the summer and for the lake water only. The sub-surface water has the usual iron group impurities.

The raw water pumps for both the sub-surface and lake water call for no particular comment. As usual, they are of the vertical compound type, but they have recently been reconstructed to admit of the higher pressures and increased power given by a new battery of Babcock type boilers working at a pressure of sixteen atmospheres (say, 235 lb.) fitted with economiser and superheaters.

The filters, which are entirely of the slow sand type, have an area of 2400 square metres each (say, 26,000 square feet) and are thirty-four in number, the total filtration area thus being some 884,000 square feet. The maximum allowed filtration rates are 50 litres per square metre-hour (say, 1 gallon per square foot-hour) for the lake water and 300 litres per square metre-hour (say, 6 gallons per square foot-hour) for the sub-surface water. All the filters are covered in and in semi-darkness. On an average scraping takes place every four months and relaying about every four years, so that modern methods of sand washing and cleaning have received no study, the job being of such a standby nature.

The sub-surface water is aerated before filtration by flowing from an overhead tank through a brick-filled chamber, joints about half a centimetre wide being left between the bricks to admit the air to the thin streams of water obtained from the numerous feed pipes in the tank bottom. These feed pipes are about 6in. in diameter and of two heights above tank bottom—say, 1ft. 6in. to 2ft. 6in.—to admit of two ranges of flow. The flow is controlled by penstocks from a main channel.

The main pumping station is particularly interesting. Here steam has been entirely eliminated, the sources of power being electricity, supplied by the Berlin Electric Supply Company, and oil. The total pumping capacity of the station is 21,000 cubic metres (4,620,000 gallons) per hour, the present reserve being 30 per cent.

The pumps are all single-stage centrifugals. Those motor driven are of the vertical axis type, two of them having a capacity of 1500 cubic metres (330,000 gallons) and two of double that figure. The efficiency of these pumps was given to me as 80 per cent., and this is accounted for easily by the very sweet delivery obtained to the main delivery main. Of the oil-driven pumps two are of 1500 cubic metres (330,000 gallons), two of 3000 cubic metres (660,000 gallons) capacity. They are horizontal with split casings. An efficiency of 76 to 78 per cent. is attained. Venturi meters are fixed on all delivery mains with what appeared to me extraordinarily small contraction distances. There are two common delivery mains on each side of the building, four pumps delivery into each main. The main is 1200 mm. (say, 47in.) in diameter, but it is possible for either set of pumps to pump into either main. All the pump foundations are column supported and all the delivery and common mains easily accessible. The balance of the station capacity is obtained from three 1000 cubic metres (220,000 gallons) motor-driven pumps of the usual type.

Of the four Diesel engines, two have six cylinders and develop 620 H.P. at 240 r.p.m. and two with the same number of cylinders develop 340 H.P. at 320 r.p.m. They were all built by Deutz, and the oil consumption is 175 grammes (say, 0·385 lb.) per H.P.-hour. The oil is American in origin.

A stock of 200 cubic metres (44,000 gallons) is kept in steel tanks housed in what was the old boiler-house when steam drive was used. All oil is metered to the engines. The total engine-room staff consists of ten men—five fitters and five drivers—working an eight-hour shift. The engine-room is beautifully kept. Pumping station pressures are 38 m. (say, 125ft.) to 40 m. (say, 131ft.) delivery, with a 4 m. suction head. I gathered that boosting was used for some portions of the city.

It is interesting to note that this, the first, Berlin waterworks, dating from about 1875, was erected by an English company. The memory of the first chief engineer, Henry Gill, is perpetuated by a bronze bust.

Charlottenburg Waterworks, Berlin.

This is a private water company supplying the best residential area in Berlin, which has an estimated population of about one million. The source of supply is sub-surface, the works being in woodland country about 15 kiloms. out of Berlin. In general this plant is similar to that at Cologne.

The maximum daily output is about 300,000 cubic metres, or 66 million gallons. The small pipes supplying this amount of water to the horizontal collecting mains are of 170 mm. (6¾in.) diameter, 100 in number, and fixed at 25 m. (82ft.) centres. The rest level of the sub-surface water is from 7 m. to 8 m. (say, 23ft. to 26ft.), and the depth from which water is drawn is 20 m. to 40 m. (say, 66ft. to 132ft.) below ground. The water is heavily charged with iron in addition to manganese. The iron is eliminated by aeration and filtration in the usual way.

The raw ground water is pumped to the filters by two vertical type compound pumps, similar to those in Cologne, but rather smaller. There are eight circular steel filters provided with motor, belt driven, agitators for aeration of the water about the sand surface. Of these I obtained no details, but I observed that washing was done by reversed flow. From the filters the water flows to a 10,000 cubic metre (2,200,000 gallons) reservoir, whence it is pumped into the mains.

The main pumping house equipment consists of two horizontal compound pumps of a capacity of 1500 cubic metres (330,000 gallons per hour) each, and one turbine centrifugal set with a capacity of 3000 cubic metres (660,000 gallons) per hour.

The boiler-house contains three Babcock type boilers working at a pressure of 25 atmospheres (say, 367 lb. per square inch), and employing a superheat of 180 deg. Cent.

The water is sold through meters of the inferential or the wet type.

Hamburg Waterworks.

The town of Hamburg takes four-fifths of its water from the river Elbe. The intake is 15 kiloms. (9·3 miles) out of Hamburg in open country, the river having a tidal range at this point of 2·5 m. (8ft. 2in.). The water is brownish in colour, is highly polluted, but not very turbid.

The pumping plant for the raw water consists of seven horizontal compound steam pumps, each of a maximum capacity of 2000 cubic metres (440,000 gallons) per hour. These pumps are only remarkable for the excentric driven wrist plate which actuates the valves on the pump chambers. Six pumps are so fitted, one having the ordinary spring-actuated valves. The plate type of valve have given no trouble. These pumps pump against a head of 5 m. to 6 m. (say, 16ft. 5in. to 19ft. 8in.) and are fitted with jet condensation giving a vacuum of 96 per cent. Four Lancashire boilers working at 7 atmospheres (say, 103 lb. per square inch) without superheat supply the steam for these engines, which date from 1892.

The raw water effluent passes from these pumps to a large open channel about 30ft. in width, which is spanned by a perforated wooden trough which receives the required dose of alum solution. The strength of solution is regulated by hydrometer and the amount admitted to the trough by a ball valve and slotted gate. The alum liquor containing 18 per cent. Al_2O_3 is prepared from crystalline alum of about nut size. The usual alum dose is 40 grammes per cubic metre (2·8 grains per gallon). The treated water then passes to four settling tanks of a total capacity of 450,000 cubic metres (99,000,000 gallons)† and a depth of 3 m. (say, 10ft.) by way of a channel of a length of at least half a mile, and by the time it reaches the farthest tank it has lost most of its mud. The water remains in the tank for a period of two to three days and is then chlorinated before admission to the filters, the dose being 0·6 milligramme per litre (0·6 parts per million gallons). No taste troubles were observed. The settling tanks, which are merely brick-lined basins whose sides conform to the natural slope of the lodal mud, are cleaned by gravitation to the Elbe. Cleaning takes place every three to four months. The long channel is cleaned by dredging.

The filters are all slow sand, the section being:—Fine sand, 1 m. (3ft. 3in.); coarse sand, 0·3 m. (1ft.); graded gravel, 0·3 m. (1ft.).

The absence of open-jointed pipes to the central culverts is to be noted. The maximum velocity of filtration is now 113 mm. per hour (say, 2·3 gallons per square foot per hour), but before the war filters were operated at a maximum velocity of 65 mm. per hour, or 1·35 gallons per square foot per hour. The total depth of filter is 3·4 m. (11ft.), and it is customary to run the bed down to 70 cm. (27·5in.) of fine sand before relaying. Beds are cleaned every four months and relaying takes place at five years' intervals. The average daily filtration capacity of the plant is 190,000 cubic metres (41,800,000 gallons) in twenty-two filters, each of 7650 square metres (82,000 square feet), giving a total area of 1,800,000 square feet. There is an enormous reserve of land for filter extension between the settling tanks and the existing filters. Sand washing is carried out on a home-made hopper system, the washer consisting of six hoppers in series. The feed pipe to the hoppers is about 2½in. diameter and the injector water is delivered at a pressure of about 0·3 atmospheres (say, 10ft. head) for an approximate lift of 6ft. There are four such washers, the whole being capable of cleaning the sand from one filter, or 7000 cubic feet in eight hours. After filtration the water is again chlorinated with a dose of 0·15 to 0·4 parts per million gallons before passing to the two reservoirs which feed the main pumps.

The main pumping plant is accommodated in three houses, the total capacity being 23,000 cubic metres per hour (say, 5,000,000 gallons), with a reserve estimated at 25 per cent., thus giving a maximum hour of 3·9 million. The pumping head is 56 m. (say, 184ft.) average.

No. 1 Pump House.—This house contains three vertical type pumps of 500 H.P. and an hourly capacity of 1800 cubic metres (396,000 gallons) each, and five of 1200 cubic metres (264,000 gallons). The larger sets runs at 60 r.p.m. and the smaller at 42 r.p.m. The pressures in the two cases are 12½ and 10 kilos. per square centimetre (178 lb. and 142 lb. per square inch). These engines are triple-expansion with injection condensation, the smaller sets being twenty years old. Six Lancashire boilers provide steam for the larger sets and nine for the smaller. The superheat is 100 deg. Cent.

No. 2 Pump House.—This house contains two turbine sets, running at 5400 r.p.m. and with an hourly capacity of 4000 cubic metres (880,000 gallons) each. The boiler plant for these machines consists of two Babcock type boilers, each with a steaming capacity of 5500 kilos. (say, 12,000 lb.) per hour at a pressure of 16 atmospheres (say, 235 lb. per square inch). The percentage of CO_2 averages about 10 and the evaporation ratio is 8·2 steam to coal. The superheat is 200 deg. Cent.

No. 3 Pump House.—This house contains two compound vertical sets, each with an hourly capacity of 1800 cubic metres (396,000 gallons), for which four Lancashire boilers are provided. This plant is generally similar to that in Pump House No. 1.

The population supplied numbers about 1,100,000 and the daily consumption per head is about 33 gallons. The supply is charged by meter.

I am much indebted to Mr. C. D. Pearson, Engineer-in-Chief and Manager of the Shanghai Waterworks Company, Ltd., Shanghai, for permission to make use of the information contained in the above report.

* This temperature is extraordinarily low.

† There appears to be a shortage of settlement for the period of sedimentation given, but this is presumably made up from sub-surface water.

The Construction of Nomograms.

By A. L. EGAN.

The use of nomograms for the evaluation of complex quantities is rapidly becoming widespread. Complicated expressions can be solved in a few seconds with sufficient accuracy for many technical purposes. The slide rule is a wonderful instrument, particularly the 20in. size, but the slide rule will not readily solve expressions containing decimal indices such as are commonly met with in engineering and physics, nor will it add or subtract. The amount of calculation which can be saved by the use of a nomogram is astonishing. The writer has constructed one which will solve any problem on the compression and expansion of air, giving horse-power, both isothermal and adiabatic temperature changes and volume-weight ratios, almost at a glance. Several writers have written books on nomograms, sometimes at great length and often in a very involved and far from lucid manner.

The essential principles are few, and an attempt is made in the following article to set them out in simple form. The well-known properties of similar triangles are the key to nomographic representation. Most nomograms consist of a number of logarithmic scales, such as those on a slide rule, but, whereas on a slide rule one only finds two different lengths representing logs. 1 to 10, on a nomogram any length can be used to suit the formula to be represented. Nomograms

can be constructed with scales other than logarithmic, and some of these will also be discussed.

The elementary form of a nomogram is three vertical parallel lines, called axes, each marked to some scale and each representing a range of values of a certain variable. Then if any two variables are known out of three, and a pencil line be drawn between them, the unknown quantity is indicated on the remaining axis where it is cut by the pencil line.

Case 1, *Fig.* 1.—Consider three vertical axes equidistant and each marked with the same logarithmic scale in the same vertical direction, say, 10in. represents log. 1 to log. 10. Call the axes A, B and C. Draw any sloping line to cut the three axes. Then obviously s inches = log. A to scale, t inches = log. B, and u inches = log. C. By similar triangles, $q'' = s'' - t''$, so $u'' = s'' - 2\,q'' = s'' - 2\,(s'' - t'')$. Therefore $u'' = s'' - 2\,s'' + 2\,t'' = 2\,t'' - s''$. But u'' = log. C and S'' = log. A, and t'' = log. B. Therefore, log. C = 2 log. B − log. A, and

$$C = \frac{B^2}{A};\quad B = \sqrt{A\,C};\quad \text{and } A = B^2C \qquad \text{Equation 1}$$

It follows, then, that if a pencil line is drawn from the known value of "A" on the A axis, through the known value of B on the "B" axis, the value of C read on the C axis is equal to $\frac{B^2}{A}$, and so on, as in Equation 1.

Case 2.—Let A, B, and C be drawn to the same log. scale as before and equidistant, but let log. scale C run in the opposite direction, *i.e.*, downwards, as in Fig. 2.

Then $s'' = $ log. A, $t'' = $ log. B, $u'' = $ log. C. Now $q'' = s'' - t''$.

So $u'' = q'' - t'' = s'' - 2\,t''$.

Therefore $u'' = $ log. C = log. A − 2 log. B; and

$$C = \frac{A}{B^2},\quad A = B^2C,\quad \text{and } B = \sqrt{\frac{A}{C}} \qquad \text{Equation 2}$$

The relationships in Equations 1 and 2 are useful in certain formulæ, but it will be noticed that they do not include straight multiplication and division. The latter processes are not possible by nomogram if all the scales are alike, even if the inner axis is placed off the centre line between the outer axes.

Case 3.—Let the scale of B be half the scale of A and C, that is, if 10in. = log. 1 to log. 10 on axes A and C, then 5in. = log. 1 to log. 10 on scale B—see Fig. 3. Let all scales run in the same vertical direction and be equidistant.

Let $s'' = $ log. A, $u'' = $ log. C, and t'' inches = log. B.

Now $t'' = u'' + q'' = u'' + (s'' - t'')$ by geometry, so $t'' = \frac{1}{2}\,s'' + \frac{1}{2}\,u'' = \frac{1}{2}$ log. A C, but as t'' is marked to half the scale of the other axes, in this case t'' will represent twice ($\frac{1}{2}$ log. A C), so $t'' = $ log. B = log. A C; and

$$B = A\,C \text{ and } A = \frac{B}{C} \text{ and } C = \frac{B}{A} \qquad \text{Equation 3}$$

This system allows of simple multiplication—of A and C—in which the product is read on the inner, or B, axis, and it gives a simple quotient on the outer axis.

Case 4.—In Fig. 3 suppose the log. scale of B is $\frac{1}{m}$ times the log. scale of A and C, instead of $\frac{1}{2}$.

Then $t'' = \frac{1}{m}$ times (log. B to same scale), and by reasoning as in Case (3), $B = A^{\frac{m}{2}}\,C^{\frac{m}{2}}$.

This is a more general case of multiplication.

When $m = 1$, then $B = \sqrt{A\,C}$, as in Case (1).

When $m = 2$, then $B = A\,C$, as in Case (3).

Case 5, *Fig.* 4.—It is often convenient to be able to read a simple product on the outer or C axis, particularly when the product is to be further multiplied.

Let log. scales A and C be alike, but draw A downwards. Draw scale B upwards, but $\frac{1}{m}$ times the scale of A and C.

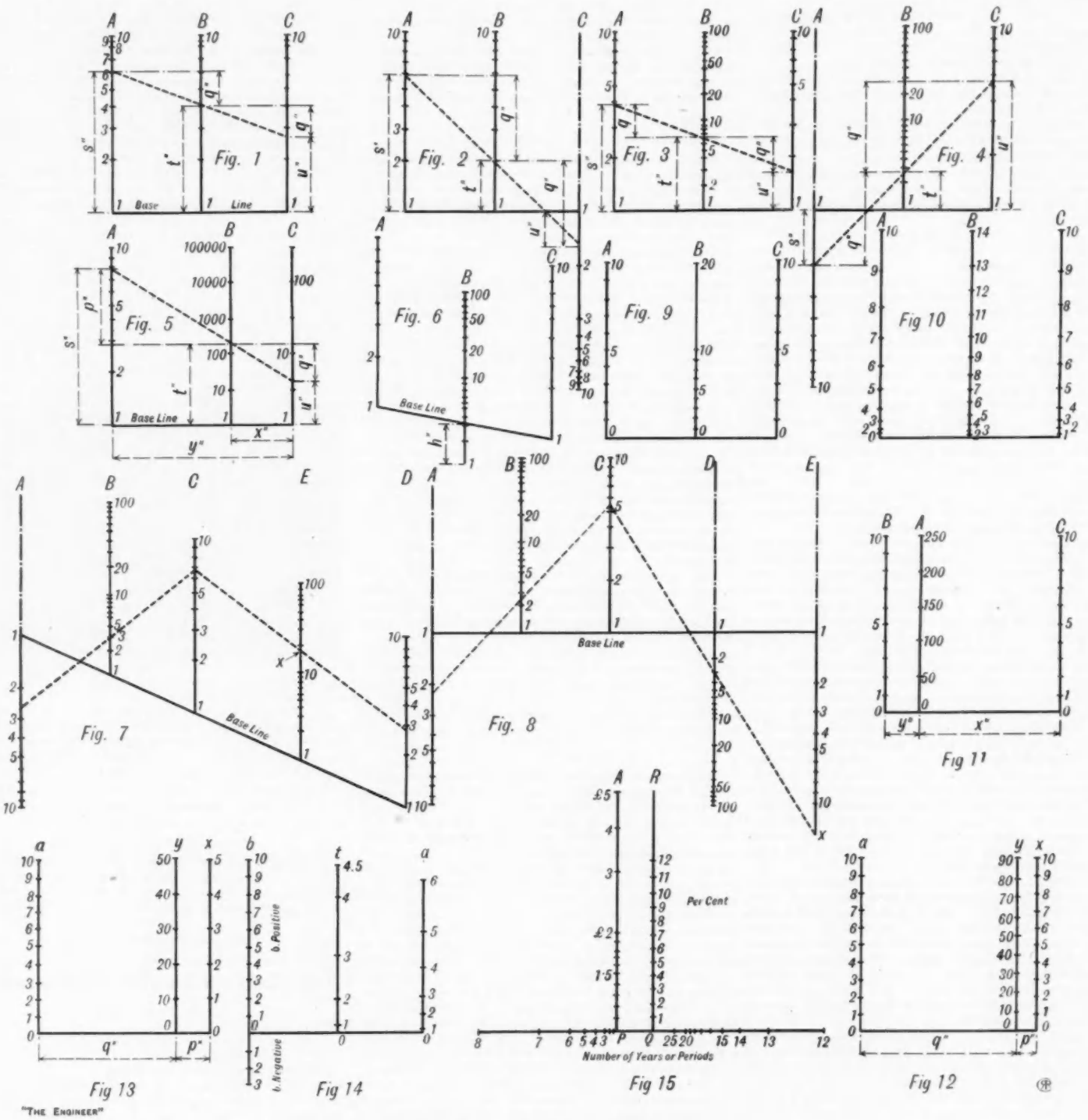
Then $s'' = $ log. A, $u'' = $ log. C, $t'' = \frac{1}{m}$ (log. B to same scale).

$q'' = s'' + t''$.

Then $u'' = q'' + t'' = s'' + 2\,t'' = $ log. C., and log. C = log. A + $\frac{2}{m}$ log. B.

So $C = A\,B^{\frac{2}{m}}$, and if $\frac{1}{m} = \frac{1}{2}$,

then C = A B, giving a product on the outer axis, and $B = \frac{C}{A}$, giving a quotient on the inner axis.



FIGS. 1 TO 15—EXAMPLES OF NOMOGRAMS

Case 6, *Fig.* 5.—General case of the product of two variables, each with a given exponent.

Let the scale of B be the basic or reference scale.

Let the scale of A be m times the scale of B.

Let the scale of C be n times the scale of B.

Then—

$t'' = \log. B = s'' - p'' = u'' + q''$. Equation 4

and—

$s'' = m \log. A$, and $u'' = n \log. C$. Equation 5

while—

$p'' + q'' = s'' - u''$ . . . . . Equation 6

By similar triangles—

$$p'' = \frac{y - x}{x} q'' \quad . \quad . \quad . \quad . \quad . \quad \text{Equation 7}$$

So—

$$\frac{y}{x} q'' = s'' - u'' \text{ from Eqn. 6} \quad . \quad \text{Equation 8}$$

From Eqns. 5, 6, 7—

$$2t'' = s'' + u'' + q'' - p'' = s'' + u'' + \left(\frac{2x - y}{x}\right) q''.$$

Substituting for q, as in Eqn. 8—

Then $t'' = \frac{x}{y} s'' + \frac{y - x}{y} u''$,

And substituting from Eqn. 5—

Then $t'' = \log. B = \frac{m x}{y} \log. A + n \left(\frac{y - x}{y}\right) \log. C.$

Therefore—

$$B = A^{\frac{mx}{y}} \times C^{\frac{n(y-x)}{y}} \quad . \quad . \quad . \quad . \quad \text{Equation 9}$$

By choosing suitable values for m, x, y, and n, any exponents of A and C can be represented, either positive or negative, fractional or integral.

In all cases the base line, or the line joining "unity" on each axis need not be horizontal, but it must be a straight line. Drawing the base line other than horizontal often helps to economise the size of sheet used for the nomogram, while keeping the scales as open as possible.

It is very important, especially when one log. scale is inverted, to see that the base line passes through "unity" on each logarithmic axis, whether the base line be drawn horizontal or otherwise.

In many formulæ the dependent variable to be evaluated is a constant times a function of the independent variable thus—

$$B = k \times (\text{function A and C}).$$

In that case there is no need to perform another operation or to draw another axis. It is merely necessary to displace vertically the scale representing the independent variable to an extent such that the displacement in inches is equal to the logarithm of the constant to the same scale as the "moved" axis.

Thus in Fig. 6, if $h'' = \log. k$ to the same scale as B, then $B = k \times$ (function of A and C).

A little consideration of a particular problem such as one in which one scale is inverted or one in which k is less than unity, will readily indicate in which direction h inches are to be measured.

It is frequently necessary to evaluate expressions containing more than two independent variables such as E = A B D. In that case one must evaluate A × B on a C axis, and then find E by running a line from the point on the C axis to a point on a "D" axis to cut E on an E axis, as in Fig. 7. The value of E is read at x. The C axis need not be graduated, but its assumed scale and direction must not be lost sight of when constructing the nomogram. Fig. 8 shows an alternative method, useful if E is itself to be afterwards multipled on further axes to the right.

In the examples illustrated—say, Fig. 8—the distance between axes C and D and D and E must be equal, but not necessarily the same as the distance between axes A and B and B and C. Nomograms can also be constructed with scales other than logarithmic, and one or two special cases are of interest and utility.

If the outer axes A and C are marked directly proportional to the numbers themselves—*i.e.*, equally divided—and the central axis B is marked half the scale of the outer axes, then B = A + C, which is a method of adding—see Fig. 9.

In Fig. 10 the outer axes are marked directly proportional to the "squares" of the numbers indicated. Thus, the (1) mark is $(1)^2$ divisions above zero on the base line, the (2) mark is $(2)^2$ divisions above zero, the (9) mark is 81 divisions up, and so on. The markings on the central axis B are half the pitch of those on the outer axes. If A and C are the known independent variables, a line joining them cuts the B axis and indicates a value of B such that $B = \sqrt{A^2 + C^2}$. In other words, B is the hypotenuse of a right-angled triangle, having sides A and C, and this nomogram is a useful one.

Another form of nomogram is seen in Fig. 11, in which the scales are proportioned to the marked number—*i.e.*, equally divided—but are not necessarily alike, and the nomogram will solve the formula $A = m B + n C$, where m and n are constants. Decide on a scale for B and call it k, then the scale of A must be $\frac{x'' k}{(x'' + y'') m}$, and the scale for C must be $\frac{n x k}{m y}$.

If the C scale is inverted, then $A = m B - n C$.

A nomogram for the straight line law, $y = a + b x$, is given in Fig. 12. This equation is similar to the one above, under Fig. 11, except that $m = 1$.

If the scales of a and x are both alike, then the scale of "y" must be $\frac{1}{1 + b}$ times the scales of a and x, and $\frac{q''}{p''} = b$.

If the scales of a and x are unlike—see Fig. 13—and k is the scale of a, then the scale of y must be $\frac{p''}{p'' + q''} k$, and scale of x must be $\frac{b p''}{q''} k$.

If the scales of x in Figs. 12 and 13 be inverted, then $y = a - b x$.

In constructing Figs. 11, 12 and 13, the distances between the axes p and q or x and y, and the scales of the axes, should be decided upon to suit the range of each variable or in order to give widely pitched markings for accurate reading. One or two trials with the aid of the formulæ given, will indicate the best form.

Fig. 14 is a nomogram for solving quadratic equations of the form—

$$x^2 \pm a x = \pm b \quad . \quad . \quad . \quad . \quad \text{Equation 10}$$

The "b" axis is marked in equal pitches, the "t" axis is marked according to the squares of t and to half the scale of the "b" axis, the "a" axis is marked according to the squares of "a" and to one-quarter the scale of the "b" axis. Thus, if the unit marks on "b" are $\frac{1}{2}$in. pitch, then the "3" mark on t is $\frac{1}{2} \times (3)^2$ inches above 0. The "5" mark on a is $\frac{1}{4} \times (5)^2 = 6\frac{1}{4}$in. above 0, and so on.

To solve a quadratic on Fig. 14, lay a line across the known values of a and b and read "t" on the "t" axis; add $\pm \frac{a}{2}$ to "t" and so find the two roots of the quadratic, because—

$$x = \pm \sqrt{b + \tfrac{1}{4} a^2} \pm \frac{a}{2} = \pm t \pm \frac{a}{2} \quad \text{Equation 11}$$

If the sign of a in Equation 10 is plus, then the sign for $\frac{a}{2}$ in Equation (11) is minus, and *vice versâ*.

Fig. 15 is an original example of a nomogram having both vertical and horizontal axes. It will compute compound interest, and a line run from the "period" mark on the horizontal axis through the rate per cent. mark on the "R" axis, shows the amount of £1 on the A axis. "R" is the rate per cent. per period. The construction is as follows :—The axis A is marked proportional to log. A so that log. 1 to log. 10 is drawn, say, 10in. The axis R is marked proportional to log. $\left(1 + \frac{R}{100}\right)$, but to m times the scale of "A" ($m = 10$ as drawn). The horizontal distance from the point P to the period markings is, in inches = P Q inches $\times \frac{N}{\pm (N - m)}$, where N is number of periods.

In a diagram similar in form to Fig. 15, let the axes A and R be simple logarithmic scales of A and R, and both alike, then the horizontal axis can be marked for evaluating any exponential of the form $R = A^n$. The horizontal distance from the point P to the "n" mark is, in inches = P Q in inches $\times \frac{1}{n - 1}$; "n" can be decimal or integer, positive or negative. The axis R need not be graduated, as the value of R can be read on the axis A by running across horizontally from the pencil mark on R with a set square.

Nomograms can also be constructed with markings proportional to the reciprocals of the numbers indicated. The appended list describes a number of original and useful nomograms in a manner which does not need a diagram for each. Consider three equidistant vertical axes called A, B and C.

(1) Let A and B be marked proportional to the reciprocals of the numbers indicated, but with the B axis half the scale of A and C, and let C be equally divided; then $B = \frac{A}{1 + A C}$.

(2) Let A and C be equally divided to the same scale, and B be reciprocally marked to half the scale of A and C, then $B = \frac{1}{A + C}$.

(3) Let all the axes be reciprocally marked, but with B to half the scale of A and C, then $B = \frac{A C}{A + C}$ while if the A scale is inverted, $B = \frac{A C}{A - C}$.

(4) Let A and C be equally divided and B be marked proportional to the reciprocal of the square root of the number indicated, but to half the scale of A and C, then $B = (A + C)^2$. Invert "C" scale, and $B = (A - C)^2$.

(5) Let A and C be marked according to the squares of the numbers indicated, and let B be equally divided, but $\frac{1}{m}$ times the scale of A and C, then $B = \frac{m}{2} (A^2 + C^2)$, and if C scale is inverted, then $B = \frac{m}{2} (A^2 - C^2)$. For $B = A^2 \pm C^2$, put $m = 2$.

When constructing most nomograms, it is only necessary accurately to mark one axis which can be copied from a slide rule in many cases; the other scales can then be marked by "similar triangles." For example, in Fig. 3, if the A scale is first marked, then the B scale can be graduated by joining each mark on "A" to unity on "C."

Pulverised Coal Plant at the Peterborough Electricity Works.

THE new power station of the Peterborough Corporation electricity department has several somewhat special features which distinguish it from other stations in the United Kingdom. Although it is not connected with any other source of electrical supply, it is operated entirely with pulverised coal, and in this respect it is believed to be original. While there are other power-houses in which pulverised coal is used exclusively, a supply of electric power can be drawn from elsewhere. There are, it is true, two stoker-fired boilers in the old Peterborough station, but they have not been used to any extent since 1927, and even if they were called upon to provide steam, they could only deal with a small fraction of the normal load. For all intents and purposes, therefore, the station is entirely dependent upon pulverised coal, a fact which speaks well for the reliability of the pulverised coal-firing equipment. The station is believed, moreover, to be the only one in this country, and probably in Europe, in which there is no division between the turbine and boiler-rooms, an arrangement which demonstrates that the use of pulverised fuel may result in remarkable cleanliness. The absence of a dividing wall between the turbine-room and boiler-house—see Fig. 1—facilitates supervision, for the shift engineer can see the turbines and boilers from the same position. An even more remarkable feature of the station is that it is the only coal-fired station in existence in which there is no coal storage in any form in the boiler-house, the coal being stored in a large pulverised fuel bunker in the pulveriser house—Fig. 2—which also contains the feeders and primary air fans regulated by distant electrical control from the boiler-house. Overhead bunkers are therefore completely eliminated, with the result that very much more light is available than usual. Still another feature is that the air for combustion that is delivered at the burners is not drawn from the boiler-house itself. The quantities of air needed for large boilers are such that when, as is usually the case, they are drawn from the boiler-house, they entirely upset the ordinary system of ventilation. By taking air from outside the boiler-house this trouble is avoided.

Up to the year 1921 the Peterborough electricity undertaking was a very small concern, operated with old Lancashire boilers. Designs were prepared in that year, however, for a completely new station, and four Vickers-Spearing boilers with chain grate stokers, each capable of evaporating 25,000 lb. of steam per hour, were ordered. During the course of construction, however, it was decided to experiment with pulverised fuel, with the result that the order for the stokers for two of the boilers was cancelled. In their place, two Simon-Carves unit-type pulverisers were installed. In 1923 this plant was put into commercial use and continued to work until the end of 1927, when the present station came into operation and relieved the old station of its load. The old station, which is quite inadequate to meet the present demands, now merely serves as a partial standby, and is not run under normal conditions. Experience with the refractories in the combustion chambers of the pulverised fuel boilers led to the design and installation in 1925 of a special water-cooled combustion chamber on one of the boilers, this being the first water-cooled combustion chamber to be installed in this country.

Increased efficiency, the possibility of burning low-grade fuels and greatly increased boiler evaporative capacity, were found to be the advantages to be derived from pulverised fuel. While the stoker-fired boilers never gave an output beyond their rated capacity, the pulverised fuel boilers were operated regularly up to 40,000 lb. per hour, and in a case of emergency an output of 60,000 lb. per hour was reached for a short period. During the four years in which the new boilers in the original station were in commission the pulverised fuel fired boilers evaporated 70 per cent. of the whole of the steam produced. In view of these results, it is not surprising that when the engineer came to design the new station he decided to continue the use of pulverised coal. Unlike the old plant, however, that in the new station is a central or storage system plant. A diagrammatic arrangement of the plant is given in Fig. 4, whilst Fig. 6 shows the general lay-out.

DRYING PLANT.

From an overhead hopper the raw coal is delivered through a feeder of the oscillating type into a dryer of the horizontally inclined rotary pattern, which is fired with pulverised fuel in a brickwork combustion chamber at one end. By means of an exhauster fan, secondary air is induced through ports in the walls and regulated by a series of dampers arranged in the casing. The dryer, which is shown in Fig. 9 on page 574, consists of two concentric cylinders, approximately 45ft. long, and into the annular space between the two cylinders the coal is fed. The rotation of the cylinders at four revolutions per minute causes the coal to be lifted by means of shower plates, and owing to the inclination of the dryer the coal is propelled along to the outlet end. The hot gases which are formed with the combustion of pulverised fuel, with a large excess of air, enter the inner shell of the dryer at a temperature of 1000 deg. Fah., and after passing through the inner cylinder they return through the annular space in contact with but counter-current to the coal. At the point where the gases leave the inner cylinder and enter the annular space, a temperature of 700 deg. is maintained, whilst after leaving the annular space at the inlet end, their temperature has been reduced to 175 deg. Fah. A constant speed exhauster fan controlled by a damper draws the gases from the dryer and delivers them through two cyclones in series, to which the vent from the milling system is also connected. Supplementary air plant, designed to stop the emission of coal dust from

the dryer cyclones, draws away these gases and delivers them to the burners of the boilers. The nuisance arising from dust discharged from the dryer cyclones and the loss of coal are thereby eliminated. On leaving the dryer the coal passes through a series of screw conveyors to an elevator, which delivers it into the dry coal bunker in the adjacent pulverising house, to be seen in Fig. 2.

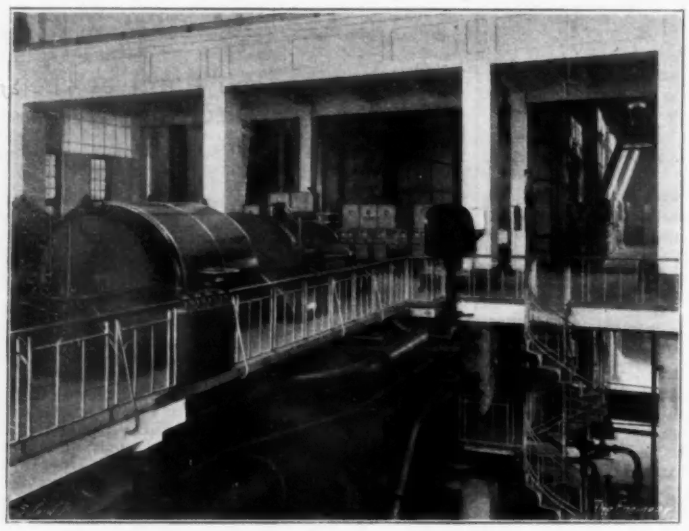


FIG. 1—COMBINED TURBINE ROOM AND BOILER HOUSE

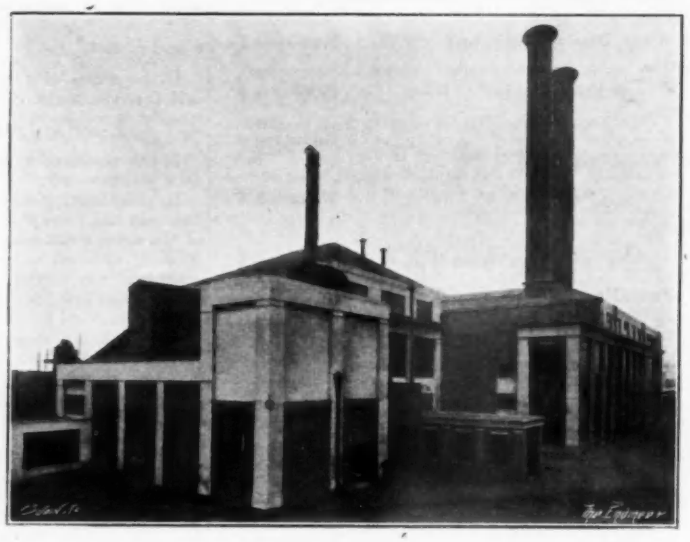


FIG. 2—PULVERISING HOUSE AND POWER STATION IN BACKGROUND

PULVERISING PLANT.

From the dry coal bunkers the coal is delivered into a Simon-Carves multiple ball-type pulveriser, shown in Fig. 3 and Fig. 10 on page 574, consisting of a cylindrical steel casing, approximately 12½ft. long by 7ft. in diameter, and with manganese steel liners. In this casing a charge of 16 tons of hard steel balls is placed, the balls having at the outset diameters of 80 mm. and 40 mm. The casing is carried on large hollow trunnions, and is rotated through reduction gearing at a speed of 21 revolutions per minute by means of a constant speed motor. As soon as the coal has been pulverised to the desired degree of fineness, air drawn through the mill by a specially designed exhauster fan picks up the coal and delivers it through a separator to a cyclone situated above the pulverised coal bunker, where the coal is separated out, any over-size material being trapped by the separator and returned to the mill. The return from the cyclone is divided, and delivers the air to the inlet and outlet ends of the mill in quantities determined by a series of dampers in the system.

PULVERISED COAL STORAGE, FEEDERS AND PRIMARY AIR FANS.

The pulverised coal from the cyclone is delivered into a screw conveyor, which carries it to any desired section of a pulverised coal bunker, which is built up of mild steel plates and has a capacity of 240 tons. The bunker is divided into four sections, each terminating in six outlet hoppers, for it has been designed to serve the complete station, which will contain six boilers, each fitted with four burners. At present, however, only two boilers have been installed, so that eight of the outlets are equipped with feeders, the remaining sixteen being temporarily blanked. Each feeder has a capacity of 5000 lb. of pulverised coal per hour, and is driven by a small variable- speed electric motor, as shown in Fig. 11 on page 574. The feeders, which are of the Simon-Carves plate type, consist of a spider which rotates between two fixed plates, as shown in Fig. 5. In the upper plate there is a port through which the coal from the bunker can fall by gravity into the spider, whilst in the lower plate there is an outlet through which the coal can fall by gravity when fed by the rotation of the spider. The coal falls by gravity assisted by a stream of inspired air to an ejector in the primary air pipe, where it is intimately mixed with the primary air in transit to the boiler. There is one electrically driven primary air fan for each feeder.

The mixture of primary air and coal is delivered through a cast iron pipe to the burner on the boiler, the primary air pipes being placed along with the other pipes in an underground culvert which also serves as an air duct for secondary air. Counters are fixed to each of the feeders, so that the coal can be measured by means of the revolutions of the feeders. The primary air fans and feeders are remotely controlled from the control panel on the boiler-operating platform. In a similar manner, pulverised fuel is supplied to the dryer combustion chamber by a small feeder of 1000 lb. per hour capacity, the feeder and fan being remotely controlled from the dryer house.

BOILER-HOUSE EQUIPMENT.

At the ground level each boiler is equipped with a secondary air fan, driven by a constant-speed motor, to be seen in Fig. 12 on page 574. The fans draw their air from the culvert, which contains among other pipes the primary air pipes, so that, as already explained, none of the air for combustion is drawn from the boiler-house. Thus the ventilation of the building is not interfered with. The secondary air fans deliver through mild steel trunking, which divides into four branches, each of which is controlled by a damper. From the culvert the primary air pipes rise vertically and enter the secondary air branches just before the burners, the nozzles of which are composed of fire-brick, so as to avoid using secondary air for cooling any burner that may be idle. The cast iron mixing chambers above the brickwork nozzles are designed to give a sharp change of direction from the horizontal to the vertical, so as to achieve maximum turbulence in the simplest possible way without the complication of fixed or movable vanes. The two middle burners of each boiler are also connected to the subsidiary air main. When the coal dryer is in operation these burners are supplied with a portion of their secondary air through this connection, thus receiving slightly preheated secondary air and at the same time consuming the fine coal dust which would otherwise escape past the cyclone into the atmosphere. The

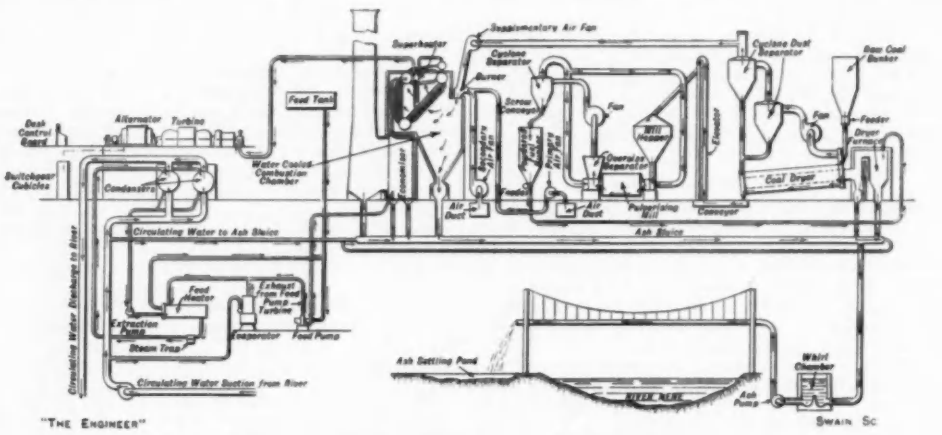


FIG. 4—DIAGRAMMATIC ARRANGEMENT OF PULVERISED COAL PLANT

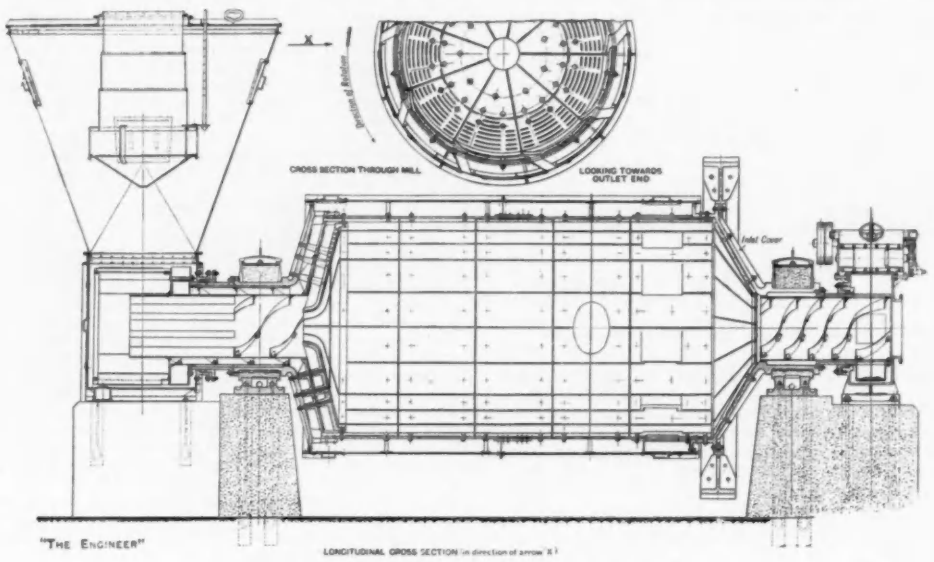


FIG. 3—MULTIPLE BALL-TYPE PULVERISER

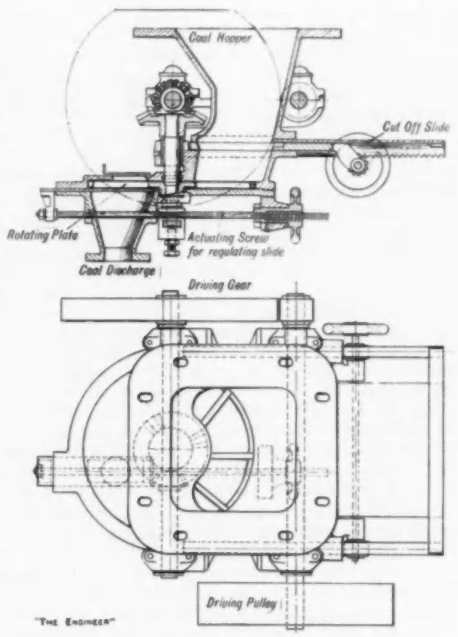


FIG. 5—ARRANGEMENT OF FEEDER

dampers controlling this supply are operated by levers which are to be seen at each end of the control panel.

CONTROL PANELS.

On the front of each boiler there is a control panel, as shown in Figs. 7 and 8, and on these panels the usual instruments, together with the remote controls for the feeders and primary and secondary air fans, are mounted. A system of coloured lights indicates whether any feeder is working or not, whilst another series of lights shows when each primary air fan has reached full speed, thus indicating to the boiler attendant when to start the corresponding coal feeder. All the controlling operations for starting, stopping and regulating the coal and air are carried out from the boiler panel, in which there is a large light the paraffin flame, after which the button on the control panel is pressed to start the corresponding coal feeder motor, and ignition of the pulverised coal takes place within a few seconds of pressing the feeder control button; that is, immediately the coal dust issues from the burner into the combustion chamber.

The steam output of the boilers is quite simple to control, being in this respect on a par with oil firing, which is a great advantage in a power station dealing with a fluctuating load. On the occasion of our visit this feature was clearly demonstrated by transferring the whole load from one boiler to another without any fuss or disturbance, the time taken being about one minute.

DRAUGHT.

The boilers work on natural draught induced by a steel chimney 160ft. high, so that there is no expenditure of power to operate induced draught plant. The passes through the boiler economiser and chimney are arranged with a view to separating out the fine ash, which results from the combustion of powdered coal, the ash being continuously discharged into a water sluice. No cyclone or grit catcher is used for this purpose, thus saving a considerable expenditure of energy, yet the chimney discharge is remarkably clean, whilst a stream of fine dust is being continuously extracted from the chimney base.

The whole of the pulverised fuel equipment described above was installed by Simon-Carves, Ltd., Mount-street, Manchester, to the instructions of Mr. H. A. Nevill, M.I.E.E., the Engineer and Manager to the Peterborough Corporation Electricity Department. We are indebted to Mr. Nevill for his courtesy in allowing us to visit the station and for supplying us with much of the information contained in this article.

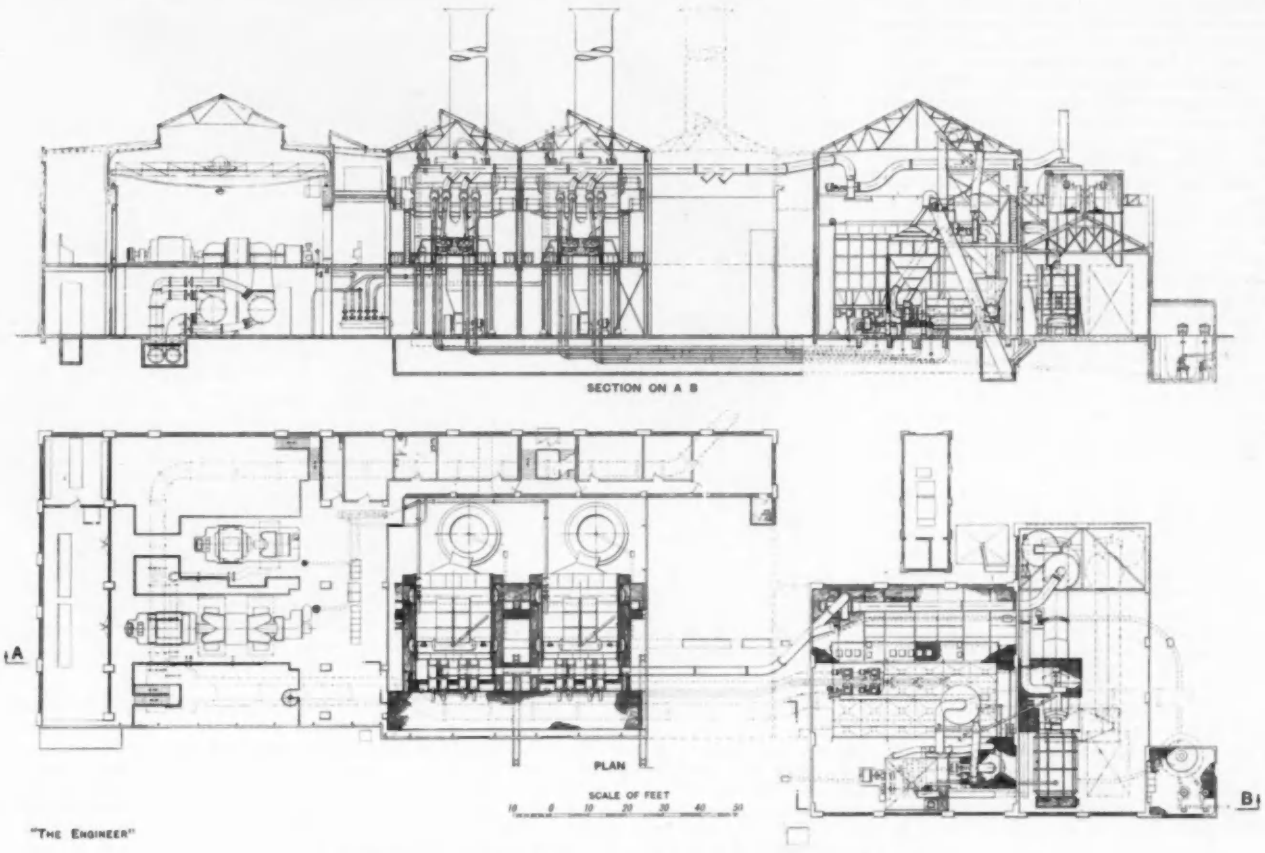


FIG. 6—GENERAL LAY-OUT OF PETERBOROUGH POWER STATION

FIG. 7—PULVERISED COAL-FIRED BOILERS

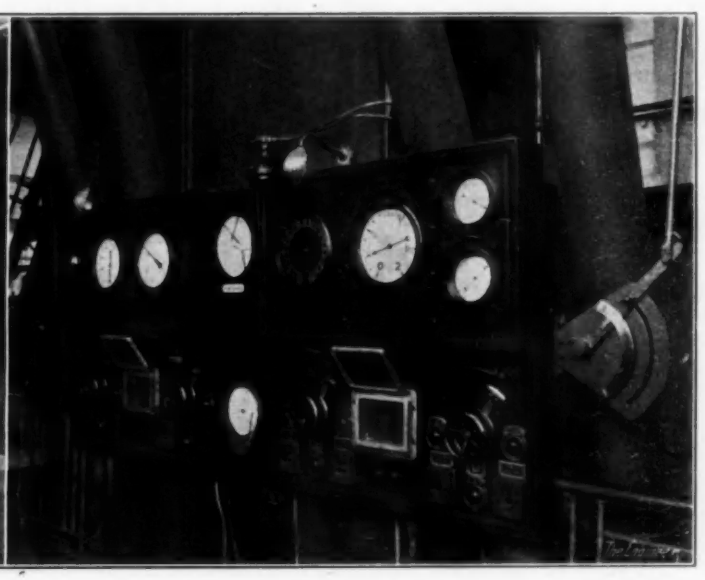


FIG. 8—BOILER INSTRUMENT PANEL

opening through which the paraffin flame is injected for lighting up the pulverised coal. The paraffin burner is mounted on trunnions in an ingenious manner, so that, when it is not required, it is swung out of position and the supply of paraffin and air is automatically cut off, whilst the mere action of swinging it into position turns on the air and paraffin. The operation of lighting up is exceedingly simple and reliable. The selected burner is swung into position and a lighted taper or match applied to

B.E.S.A. SPECIFICATIONS.

PAINTS AND PAINT INGREDIENTS.

THE British Engineering Standards Association has just issued five specifications, which form part of the series of sixty-one Paint and Varnish Specifications which have been in course of preparation during the last two years. They are :—No. 389, 1929, Zinc Chromes for Paints; No. 390, 1929, Oil Pastes (Coloured) for Paints; No. 391, 1929, Tung Oil; No. 392, 1929, White Titanium Dioxide Pigment for Paints; No. 393, 1929, Tinted Oil Pastes for Paints.

As in previous Specifications in this series, they contain clauses regulating the composition, together with standard reception tests for the purchaser of these materials; appendices being also incorporated outlining standard methods for carrying out the tests.

Copies may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each post free.

There now only remain four specifications to complete the series, namely:—Turpentine, Type 2; Aluminium Powder for Paints; Purple Oxide of Iron, Ready Mixed Paints; Venetian Reds for Paints. These specifications are being prepared, and will be issued shortly. In addition, a British Standard Schedule of Colours for Ready Mixed Paints, which is being prepared, should form a very useful guide not only to technical men but to every householder.

North-East Coast Exhibition.

No. II.*

WE continue below our account of the machinery and apparatus which are on view at the North-East Coast Exhibition at Newcastle-upon-Tyne.

W. DOXFORD AND SONS, LTD.

A noteworthy exhibit is the three-cylinder opposed-piston airless injection engine shown by W. Doxford and Sons, Ltd., of Pallion Works, Sunderland. As Fig. 12 indicates, the engine is provided with inspection platforms giving access to all parts. Such provision is rendered necessary by the large size of the exhibit, which is over 15ft. 9in. high, measured from the underside of the bed-plate, with an overall length over the bed-plate and outboard bearing of 24ft. 10in. The width of the engine is 7ft. 6in. over the bed-plate and 11ft. 6in. from the front side of the bed-plate to the back of the scavenging pumps. The designed output of the unit is some 1000 B.H.P. when running at about 184 revolutions per minute. Each of the three cylinders has a bore of 400 mm., or 15¾in., with a combined stroke of 1300 mm., or close upon 51¼in. The engine is of the firm's latest balanced type, similar to the four-cylinder quadruple-screw engines fitted in the motor passenger liner "Bermuda," a description of which machinery will be found in THE ENGINEER of December 23rd, 1927. In this design a stroke-bore ratio of a little over 3 : 1 was employed and the upper and lower pistons have different strokes.

In the Exhibition engine which we are describing, which, we understand, will be installed aboard ship when it leaves the stand, the stroke of the upper pistons is 540 mm., or 21¼in., while that of the lower pistons is 760 mm., or close upon 30in.

We reproduce in Fig. 13 a longitudinal and transverse cross section of the unit, which shows the arrangement of the scavenge air pumps. The scavenging air is furnished by a double-acting pump attached to the columns of No. 2 cylinder and driven by rocking levers and links from the lower crosshead of that cylinder. The bore of the scavenge pump is 1120 mm., or a little over 44in., with a stroke of 350 mm., or about 13¾in. Scavenge air enters the main cylinders through ports uncovered by the lower piston and the exhaust gases are discharged through ports uncovered by the upper piston. Airless injection is employed, and the three fuel pumps are mounted above the single-collar Michell thrust block at the left-hand end of the engine. They are driven by gearing from the thrust shaft at about two-thirds engine speed and all the pumps are arranged to deliver into a common main, from which connections to the fuel valves are taken. The fuel valves are two in number for each of the three cylinders, and they are diametrically opposed to each other. There are two cam shafts, one on each side of the engine, and these shafts are driven from the thrust shaft by a chain of gears. One of the upper wheels of this chain drives through bevel gearing a governor of the "Hartung" type, which controls the lifts of the suction valves on the fuel pumps and the fuel valves on the working cylinders. Both the cylinder liners and the upper pistons are arranged for cooling by means of distilled water, while the lower pistons are cooled with lubricating oil. The principal main bearings are lubricated by oil under pressure, and mechanically-operated lubricators are fitted for the lubrication of the liners and pistons of both the main cylinders and the scavenge air pumps.

Below the scavenge pumps—see Fig. 13—there are arranged four auxiliary pumps, which are driven from a crosshead attached to an extension of the scavenge pump piston-rod. Two of these pumps are circulating pumps for the fresh water cooling and lubricating oil cooling systems, and the other pumps for supplying cooling water to the fresh water and lubricating oil coolers will only be used at sea.

Before the engine was dismantled for erection at Newcastle it underwent extensive bench trials which were supervised by Professor C. M. Hawkes, of Armstrong College. In these trials, of which full particulars have been printed by the firm for distribution, two series of tests were made. The engine was first run at various powers when running at a constant speed of about 185 revolutions per minute under governor control. The power developed was measured by a Heenan and Froude water brake and the fuel consumption was also recorded for each of five loads which varied from full load down to quarter load. The other tests were carried out under marine conditions with the engine running at various torques and speeds, the torques being assumed to vary as the square of the engine revolutions. Anglo-Persian fuel oil with a gross calorific value of 19,130 and 19,330 B.Th.U. was used for the two different series of trials. Under full load governor-controlled conditions the engine developed 1018 B.H.P. at 183·8

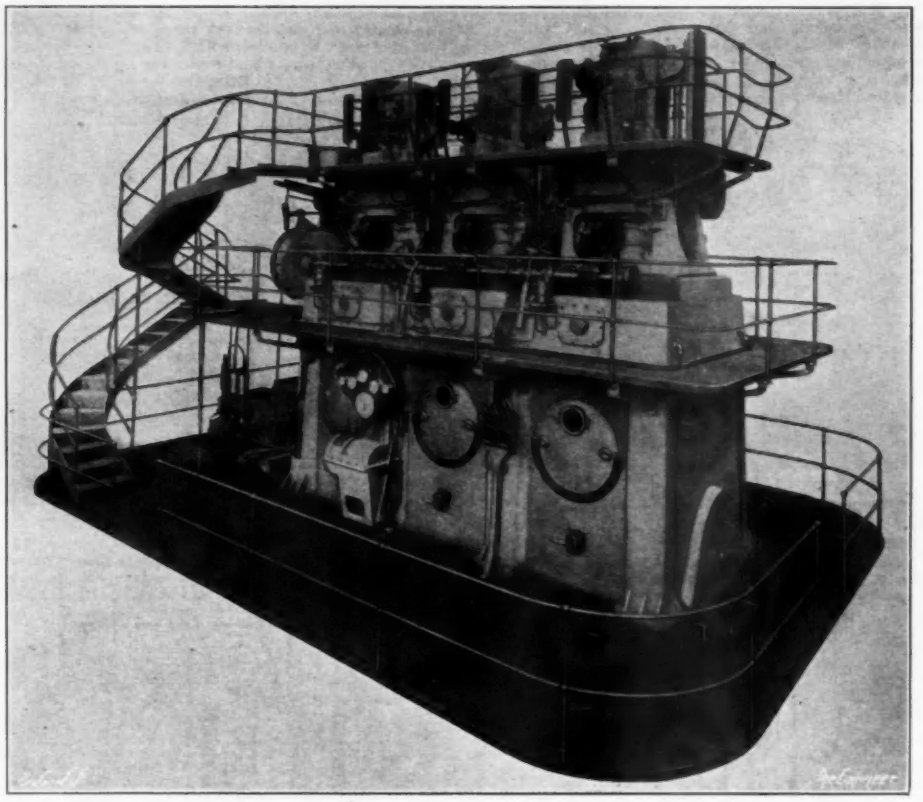


FIG. 12—THREE-CYLINDER 1000 B.H.P. OPPOSED-PISTON OIL ENGINE—DOXFORD

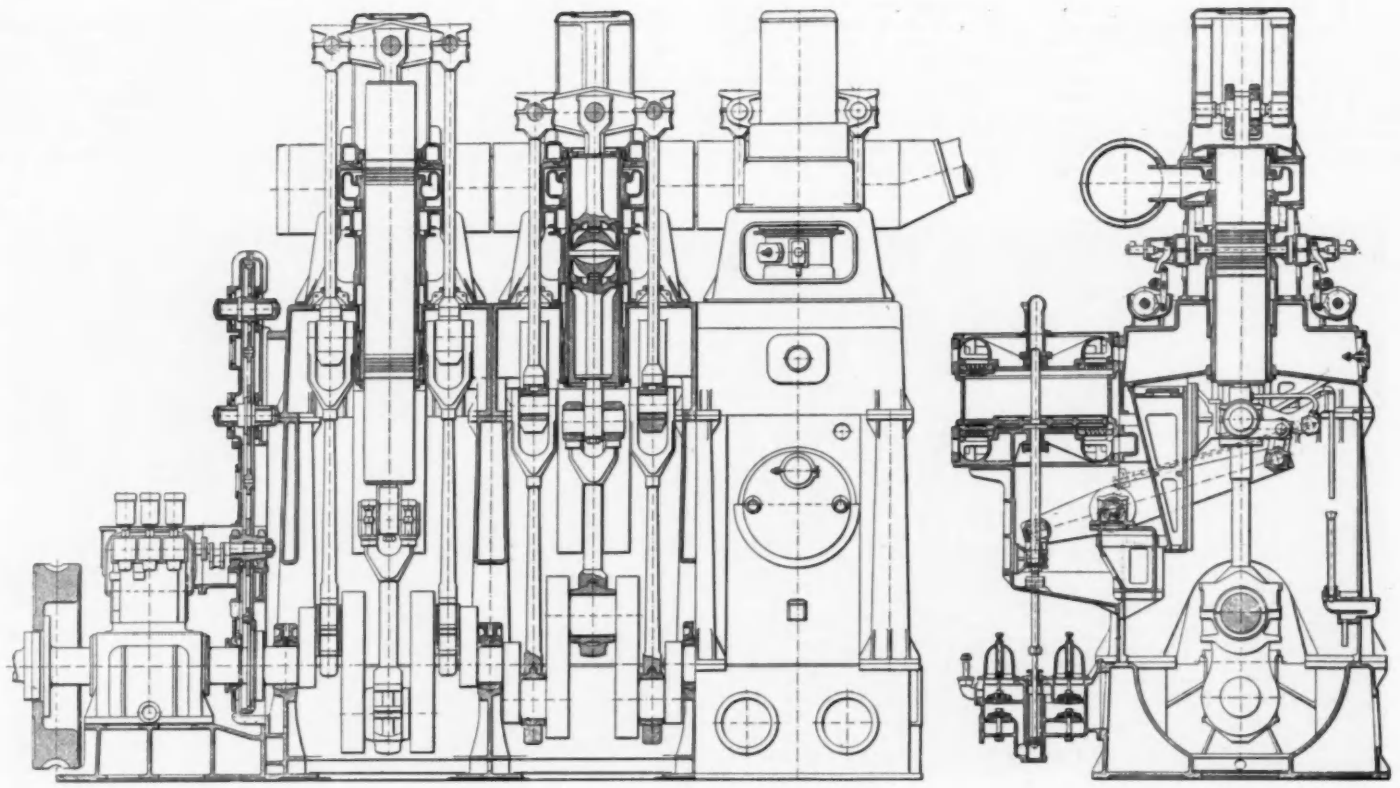


FIG. 13—LONGITUDINAL AND TRANSVERSE SECTIONS OF OPPOSED PISTON ENGINE—DOXFORD

* No. I. appeared May 17th.

revolutions per minute, and the fuel consumption was 0·363 lb. per B.H.P. hour. The corresponding figures for the full-torque trial were 793 B.H.P. and 0·355 lb. Taking the full-load trials, the thermal efficiencies of the engine worked out on the basis of the gross calorific values above given were 42 and 42·7 per cent. indicated thermal efficiency and 36·6 and 37·1 per cent. brake thermal efficiency. Throughout the trials, which took place on March 2nd and 5th, Professor Hawkes reports that the engine ran steadily and satisfactorily without an incident of any kind. The engine is exhibited in motion, being driven by chain at about 20 r.p.m. from a 20 B.H.P. motor.

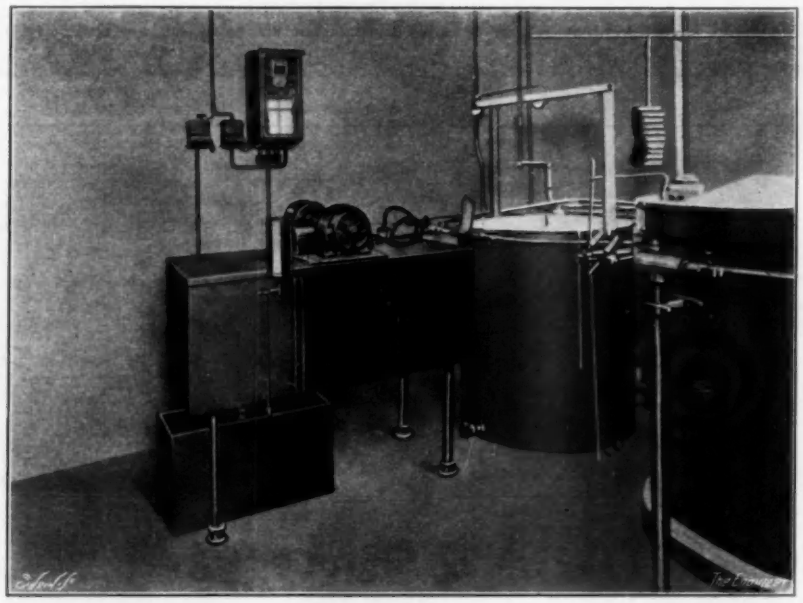


FIG. 14—THOMAS RECORDING GAS CALORIMETER—CAMBRIDGE.

THE CAMBRIDGE INSTRUMENT COMPANY, LTD.

The Cambridge Instrument Company, Ltd., of 45, Grosvenor-place, London, S.W. 1, has a stand on which there is a great variety of apparatus and instruments connected with the operation of boilers, ships and engineering works. There is also spread about the Palace of Engineering on the stands of other firms a number of instruments by the same company, and it may be well to deal with them first.

There is, for instance, in connection with the exhibit of the Newcastle and Gateshead Gas Company, a working example of the latest form of Thomas gas calorimeter—see Fig. 14—which has recently been certified by the Gas Referees for use in official testings. It consists of a tank, or calorimeter proper, and a recorder. These two parts are electrically connected, and may be any distance apart. The calorific value is determined by transferring all the heat obtained from the combustion of the gas under test to a stream of air, the rise in temperature of this air being measured by two electrical resistance thermometers used differentially and connected to the recorder. These thermometers form two arms of a Wheatstone bridge, the other two arms being fixed resistances. The recorder contains means for automatically balancing the Wheatstone bridge, and mechanism for graphically recording the calorific value of the gas on a clock-driven chart. When once standardised, the calorimeter, we are informed, maintains its calibration accurately over long periods of time.

Another Cambridge apparatus on the same stand is an automatic temperature regulator, which controls the temperature of a gas-fired furnace. It consists of a thermo-electric indicator, connected by leads to a thermo-couple in the furnace. Near the end of the indicator pointer is attached a light thermo-couple, which is electrically connected to a moving coil relay. A small electrically-heated coil is set at the point on the scale at which it is desired to maintain the temperature of the furnace. When this temperature is reached, the small thermo-couple on the pointer is suddenly heated by the coil, and the electromotive force set up in the couple energises the relay, and so completes an electrical circuit, which operates the mechanism controlling the supply of heat. As soon as the temperature falls, the thermo-couple leaves the coil and the process is reversed. The moving coil relay is connected to balanced disc valves on one spindle in the gas supply pipe. Normally the weight of the discs and their spindle is balanced by a spring, and the valve is open. When an electromagnet is energised, it attracts the armature, and the discs are forced downwards on to their seatings. The apparatus is capable of controlling the temperature to within 1 per cent. of the range of the indicator scale.

In the exhibit on the Cambridge Instrument Company's own stand a feature is a panel of boiler-house instruments, comprising a 13in. dial illuminated CO_2 indicator, a 13in. dial index thermometer for measuring the temperature of the exhaust gases, and a 13in. dial draught gauge. In the case of the illuminated dial CO_2 indicator, the actual figure representing the CO_2 percentage is illuminated by a white light, while the pointer, in line with it, is illuminated by a green light if the percentage is increasing and by a red light if it is decreasing. The scale is graduated in CO_2 percentages, the range being 0 to 18 per cent. The working of the indicator is based upon the Cambridge electrical method of CO_2 measurements.

The apparatus, part of which is illustrated in Figs. 15 and 16, comprises a CO meter connected to an indicator or a recorder, together with a CO_2 meter, soot filter and bubbler aspirator. Current is supplied by a 4-volt accumulator. After passing through the soot filter, the flue gases are washed and cooled by passing through a bubbler which forms part of the aspirator, and are drawn past a CO_2 meter of the katharometer type. The CO_2 meter contains two identical spirals of platinum wire enclosed in separate cells in a metal block, one cell containing air saturated with water vapour, whilst the other is open to the flue gas. These spirals form two arms of a Wheatstone bridge circuit. Changes in the percentages of CO_2 in the flue gas surrounding the only spiral cause changes in the conductivity of the gas and consequent changes in the galvanometer deflection. After passing the CO_2 meter, the gases are then directed into one cell of a second (CO) meter of similar design to the CO_2 meter, and into a small electrically heated furnace, where any carbon monoxide present is converted into CO_2, and any hydrogen and methane into CO_2 and water. The converted gases are finally passed through the second cell of the CO meter and back to the aspirator. The CO_2 meter, therefore, measures the increase in the CO_2 content of the gases caused by their passage through the furnace. This increase depends on the amounts of CO, hydrogen and methane originally present, and is shown on the indicator scale or on the recorder chart as a percentage of combustible gases. A portable instrument for giving readings of CO_2 percentage and temperature at various positions in the flues is also included in the exhibit.

A dissolved oxygen recorder exhibited on this stand records the percentage of oxygen in boiler feed water on a calibrated chart, thus checking the working of

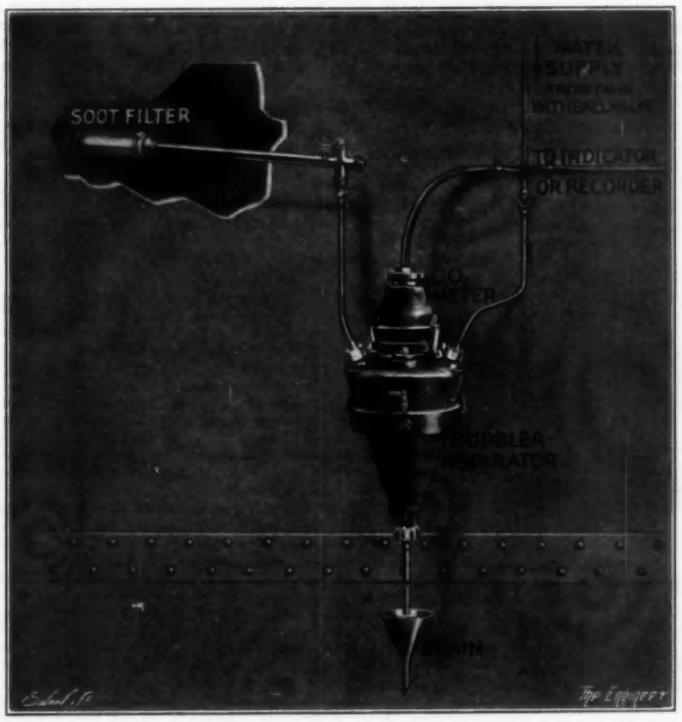


FIG. 15—ELECTRICAL CO_2 METER—CAMBRIDGE

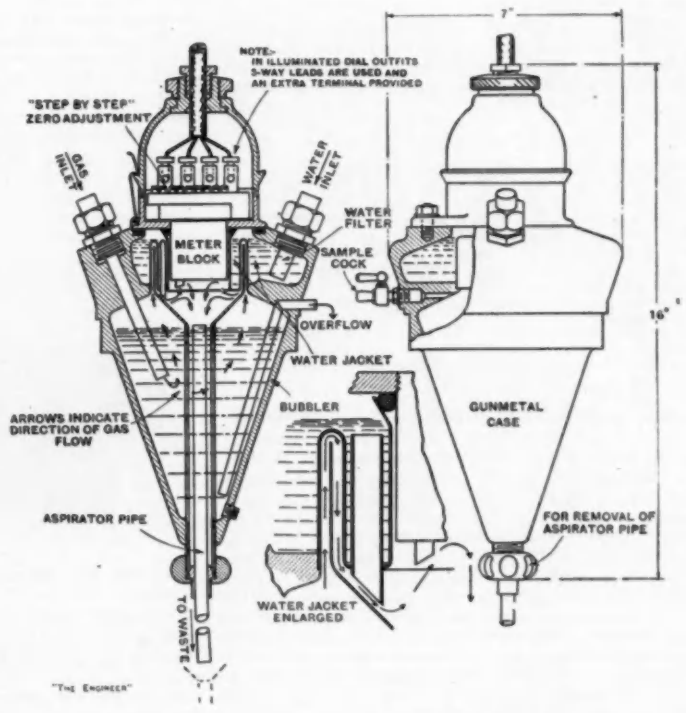


FIG. 16—ARRANGEMENT OF CO_2 METER—CAMBRIDGE

deaerators and enabling the corrosion of boiler tubes to be reduced to a minimum.

Amongst draught and pressure gauges exhibited in this stand, mention may be made of a three-dial draught gauge, which has been designed for use in connection with modern balanced-draught boiler plants. The instrument comprises three separate gauge movements of the diaphragm type, mounted together in a rectangular metal case provided with three dials. The usual arrangement is for the upper dial to indicate the draught at the flue before entering

the stack, the centre dial to show the pressure or vacuum in the grate, and the lower dial the pressure of the forced draught fan. The scales, which are 6in. long, are usually calibrated for the ranges 0in. to 2in. of water draught, — 2in. to + 2in. of water pressure, and 0in. to 6in. of water pressure.

A pressure and temperature recorder, which is shown, combines the mechanism of a pressure recorder with a mercury-in-steel thermograph, and may be used for steam, liquids or gases. It is fitted with two pens which record side by side on one chart, one pen being arranged to record the pressure, while the other is moved in accordance with fluctuations in the temperature as measured by a mercury-in-steel bulb. The bulb is connected to the recorder by flexible capillary tubing, which may be any length up to 50in. The instrument can be used for temperatures between — 40 deg. and + 1000 deg. Fah., and for pressures or vacua between — 50 lb. and + 2000 lb. per square inch. It is calibrated to cover only the working range, thus ensuring an open scale. The charts are 9½in. in diameter.

Various patterns of indicating thermometers—mercury-in-steel—with dials 8in. and 13in. in diameter, are shown, together with recording thermometers with charts 9½in. in diameter.

The Cambridge optical pyrometer to be seen on this stand is a portable instrument with a range between 700 deg. and 4000 deg. Cent. By rotating the eyepiece a beam of monochromatic light from the hot body is adjusted to be of the same intensity as a beam of light from a standard incandescent lamp; attached to the eyepiece is a pointer which indicates the temperature directly upon a clearly divided scale. The disappearing filament pyrometer, also exhibited, is a simple, portable and inexpensive instrument, for use where the high accuracy of the former instrument is not required. It is capable of measuring temperatures up to 2100 deg. Cent., and comprises an electric lamp, a small ammeter and a rheostat. The current through the lamp is adjusted until the top of the filament is of the same brightness as the hot body, and disappears when viewed against it. The temperature is then read on the ammeter scale.

The exhibit includes a hydrostatic type of regulator, designed for controlling the temperatures of tanks or chambers between the limits of — 10 deg. and + 550 deg. Fah. A valve in the steam supply—or the other means employed for applying heat—is fitted with a diaphragm chamber, so arranged that when suitable water pressure is applied to the diaphragm, the valve closes and the supply of heat is cut off. The water pressure is applied through a regulating device, controlled by means of a vapour pressure thermometer of the dial type. This thermometer has a dial 4in. in diameter, with a scale length of approximately 8½in. The bulb of the thermometer, which is exposed to the temperature to be controlled, is connected by capillary tubing to two pressure tubes in parallel, one of which is connected to the dial pointer—thus indicating the temperature—while the other tube is connected by a link to a pivoted lever which projects inside a chamber—see Fig. 17—and carries

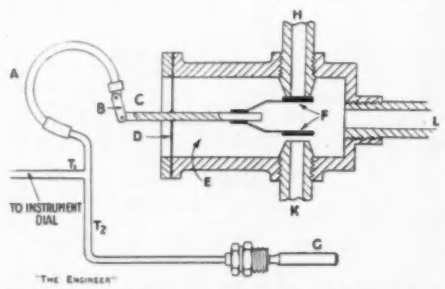


FIG. 17—HYDROSTATIC REGULATOR—CAMBRIDGE

at its end two pads F, which form valves at the ends of two pipes H and K, connecting the chamber to the water supply, and to an outlet for the waste water. A third pipe L connects the chamber to the diaphragm valve in the steam supply pipe. When the temperature of the tank—or other device being controlled—is below the point at which it is to be regulated, the lever will take up a position such that the inlet or water supply pipe is closed, and the outlet pipe is open. There is consequently no water pressure on the diaphragm, and the steam valve is open, thus allowing the supply of heat to pass to the tank. As the temperature rises, the pressure tube A is opened out, causing the lever to be tilted so as to close the outlet pipe, and if the temperature rises still further so that the critical point is passed, the inlet pipe is opened, admitting the water to the diaphragm under pressure and closing the steam valve. In practice, when the control temperature is reached, the lever takes up a position such that both inlet and outlet pipes are practically closed. The diaphragm valve is thus held in such a way that the right amount of steam is constantly supplied, and the valve will only be wide open or fully closed when sudden temperature changes have taken place. Provision is made whereby the temperature at which the regulator operates may be easily adjusted. This form of regulator can also be adapted to operate large valves requiring a considerable amount of power, in which case a modified form of valve control is provided.

DRYSDALE AND CO., LTD.

Some interesting examples of modern pumping machinery for marine installations are to be seen on the stand of Drysdale and Co., Ltd., of Yoker, Glasgow, which firm is exhibiting jointly with the associated firm of G. and J. Weir, Ltd., of Cathcart, Glasgow. In Fig. 18 we show three examples of electrically-driven vertical pumps specially designed for pumping fresh or salt water, condenser condensate, and lubricating and fuel oils respectively. The pump on the left of Fig. 18 is one of the firm's patented "Centrex" type, which is built in several sizes, with outputs from 18 tons per hour up to 400 tons per hour

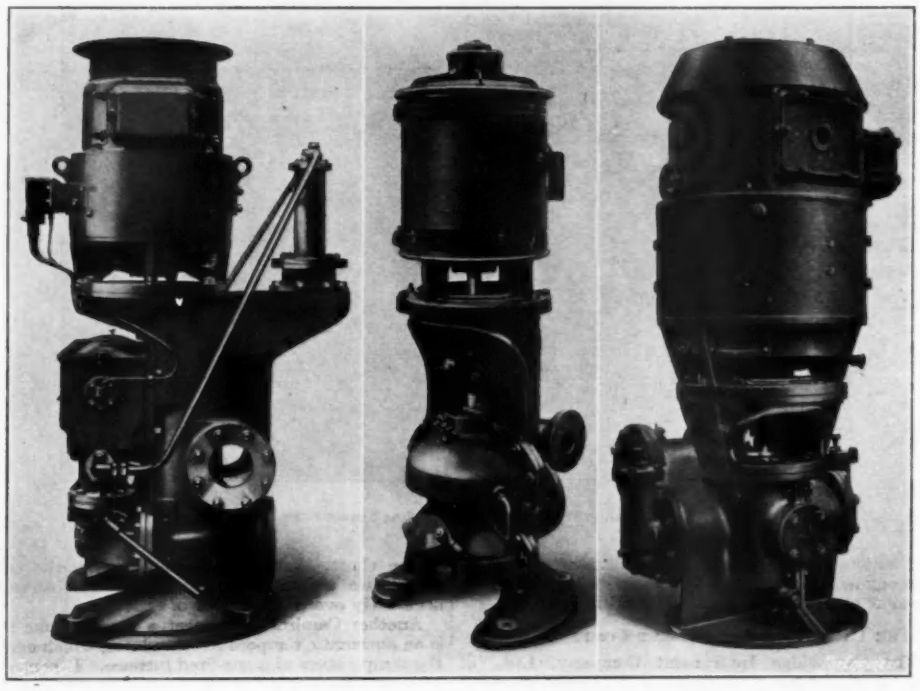


FIG. 18—"CENTREX" "PERVAC" AND "VERTOIL" ELECTRICALLY-DRIVEN PUMPS—DRYSDALE

for the various duties of fire and bilge, ballast and feed cooling water and drinking water pumps. For oil pumping the same design can be obtained in units from 70 up to 325 tons per hour delivering against pressures up to 50 lb. per square inch. At the top of the pump will be seen the enclosed and ventilated drip-proof motor, which is mounted on the pump pedestal, and in front of which the mechanical lubricator is carried. The pump casing is so divided that the suction and discharge branches are conveniently arranged at the back of the unit, which enables the pump impeller to be taken out without having to break any pipe joints. At the rear of the pump an air separator is arranged, with a baffle over which the water or oil is caused to flow on its way to

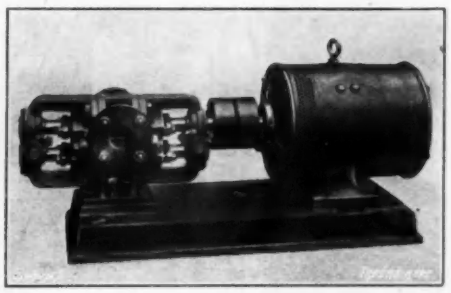


FIG. 19—"HORZOIL" PUMP—DRYSDALE

the impeller. Any air present in the stream is thereby separated out and rises to the top of the casing, from which it is removed by an air pump to which the separator is connected by pipes with non-return valves. The air pump is a two-cylinder single-acting unit which is enclosed in a crank case with a detachable top. This will be seen at the front of the pump immediately above the impeller casing. A float-operated valve gear of special design is fitted, which prevents water or oil from reaching the air pumps when no air is present in the liquid to be pumped.

For convenience when inspecting the pump a hand hole is provided at the front of the pump for access to the impeller eye. As will be seen from the view reproduced, the pump casing is extended down to form the motor stool in such a way that the alignment of the pump and motor cannot be disturbed by the expansion or contraction of the pipes. The centre pump in Fig. 18 is one of the new series of "Pervac" patented pumps for condensate extraction. For this pump, too, a vertical design has been adopted, but the pump suction is arranged at the lowest level possible to ensure good drainage of the condenser. An air trap is formed in the suction branch and provision is made for leading to this trap any air present, which is separated out at the eye of the first impeller. A suitable connection is made from the air trap to the condenser. From the first lower impeller the whole of the water passes to the second or upper impeller, above which a pressure chamber is arranged. The pump spindle passes through this pressure chamber so that there is no leakage at the pump gland. An adjustable outside bearing is fitted between the pump and motor shafts, which are connected by a solid coupling.

It is claimed that the two-stage propeller arrangement promotes steady and efficient working, as the first impeller can be designed to meet the best possible vacuum conditions, while the second impeller has to deal only with the external head and its working is unimpaired by the vacuum conditions. The right-hand pump in Fig. 18 and that shown in Fig. 19 illustrated are pumps of the firm's "Vertoil" and "Horzoil" types. These are rotary gear wheel pumps, and the vertical pumps are made in three sizes with designed outputs of from 26 up to 71 tons per hour, while the horizontal pumps are made in four units with outputs from 4¾ up to 50 tons per hour.

Other exhibits include a compound steam engine and a turbine pump, also a low-lift pump with a split casing.

(To be continued.)

BOOKS OF REFERENCE.

"THE Water Engineer's Pocket Book and Directory 1929." Published by *Water and Water Engineering*, 30 and 31, Furnival-street, Holborn, London, E.C. 4. Price 8s. 6d.—This is a really excellent little book of reference. It contains information regarding a wide range of subjects likely to be of use to water engineers, and presents it in such form as to be readily of service, though we would venture to suggest that, in future editions, the index might helpfully be very considerably extended. To detail the contents of the volume in full would be impossible in the space at our disposal, but the following general outline will serve to give some idea as to its scope. After an opening section concerned with "Water Laws," there is a section devoted to hydraulic data and formulæ, the subject being subdivided under four headings:—(A) General Tables; (B) Rainfall, Compensation and Storage; (C) Aqueducts, Pipes and Distribution; and (D) Purification of Water. The next section deals with pumps, pumping engines, &c. Noteworthy features in all the foregoing are that for nearly every subject there is a quotation bearing on it from some recognised authority, and that everything is treated from a practical standpoint. The next section includes (i.) an alphabetical list of water engineers and the authorities to which they are attached; (ii.) a directory of water undertakings which gives the chief officers, the area supplied, the source of supply, the character of the water, treatment, distribution, &c.; and (iii.) waterworks statistics, including population and area served, consumption, storage capacity, length of mains, &c. Then, after a couple of pages setting out special purpose charges for water, there is a short section giving the prices for waterworks plant and material which were actually paid during the past year. Finally, particulars are given of various institutions and Government Departments.

Railway and Road Matters.

THE dangers of the occupation level crossing were again made manifest on May 14th, when the down Flying Scotsman—the 10 a.m. from King's Cross to Edinburgh—collided with a motor lorry, 3 miles south of Dunbar. The motor was wrecked and its driver killed.

IN our leading article of April 5th on "Railway Signalling," we said that Mr. A. F. Bound had become the chief signal and electrical engineer of the London, Midland and Scottish Railway on April 1st. Whilst that statement was, in fact, quite true, it was not until May 20th that Mr. Bound actually took definite charge.

THE London, Midland and Scottish Company increased its services from and to Barking in the rush hours as from May 8th. As it was stated that that had been made possible by the delivery of new electrically operated stock, it is obvious that the increase is in the service of the Metropolitan District Railway, which company's trains run over the L.M.S. Tilbury lines to Barking.

IN view of the fact that the remission of the Railway passenger duty will be equivalent to the creation of a capital sum of £6,500,000, it may be noted that the companies have budgeted for the expenditure of £6,873,000 out of capital this year. That sum is allocated as follows:—New works, £4,012,000; rolling stock, £177,000; plant in railway workshops, £525,000; road vehicles, £405,000; steamers, £479,000 (includes L.N.E. £235,000 and Southern £200,000); docks, £1,101,000 (includes Southern at Southampton £780,000); and other items, £174,000. The total for the four companies was L.M.S., £2,426,000; L.N.E., £1,242,000; G.W., £914,000; and S.R., £2,291,000.

ADVOCATES of reform on the railways may find some ammunition in the attitude of the railway companies as to third-class sleeping accommodation. In December, 1922, a question on that subject was asked in the House of Commons, and Colonel Ashley then replied that the matter had on several occasions been considered fully by the railway companies, and the conclusion arrived at had always been that the provision of third-class sleeping accommodation was not commercially feasible. In contrast to the opinions expressed six years ago, we now have Colonel Ashley stating, just before Parliament broke up, that the railway companies are satisfied with the use made by the public of third-class sleeping accommodation, and are building more coaches of that type.

IN connection with the description of the Guest, Keen and Nettlefold steel sleeper, which appeared in our issue of April 12th, it may be noted that, according to an article by Mr. A. S. Quartermaine, assistant engineer, Great Western Railway, in the May issue of the *Great Western Railway Magazine*, half a mile of line, between Risca and Cross Keys on the Western Valleys branch has been relaid with steel sleepers, and 40 chains near Twyford. The former has comparatively sharp reverse curves, and the latter carries high-speed traffic. In both cases the sleepers are 8ft. in length, but another half-mile at Twyford is now having sleepers 8ft. 6in. in length. An experimental length in the up main line opposite the locomotive shops at Swindon is to have 8ft. and 8ft. 6in. steel sleepers and 8ft. 6in. timber sleepers.

THE total tonnage of freight—excluding free-hauled traffic—conveyed on all the standard-gauge railways in Great Britain during February was 25,818,253, a decrease compared with February, 1928, of 428,339 tons, or 1·6 per cent. Included in this figure was 17,105,324 tons of coal, coke, and patent fuel, an increase compared with February, 1928, of 1,018,892 tons, or 6·3 per cent. The total net ton-miles—excluding free-hauled—were 0·2 per cent. more than in February, 1928. Freight train receipts amounted to £8,238,999, a decrease of £540,480, or 6·2 per cent. The freight train miles run were 365,603 less than in February, 1928, a decrease of 3·2 per cent. The average train load increased from 128¼ tons to 132 tons, but owing to a reduction in the rate of movement the net ton-miles per engine hour decreased from 428¾ to 422¼.

IN this column on January 11th we announced the removal to Derby as divisional engineer of Mr. E. H. d'E. Darby, the district engineer of the London, Midland and Scottish Railway at Manchester, Exchange. The position thus vacated has been filled by the removal thence of Mr. E. M. Morris, the district engineer at Fleetwood. Mr. Morris entered upon his railway career at Fleetwood, where the headquarters of the Preston and Wyre division of the Lancashire and Yorkshire and London and North-Western Joint Railway were situated. The division began at the point where the joint line left the London and North-Western main line on the north side of Preston Station, and it included Fleetwood and the two busy stations of Blackpool (Central) and Blackpool (Talbot-road). The smaller company is named first above, as the Lancashire and Yorkshire was two-thirds owner. The Wyre docks at Fleetwood belonged entirely to that company and were also under the supervision of Mr. Morris.

THE report for the year ended March 31st, 1928, of the Indian Railway Board said on the subject of the electrification of railways that a scheme for the conversion of the suburban lines of the South Indian Railway from Madras Beach to Tambaram was sanctioned during the year at an estimated cost of 42 lakhs of rupees. It was anticipated that the introduction of electric traction on that section would not only enable the railway administration to cope with the normal increase in traffic, but would considerably encourage the development of suburban passenger traffic in the area. Further examination, it was said, had to be made of the Madras hydro-electric projects and of the schemes for the electrification of the Madura–Trichinopoly and certain other sections of the South Indian Railway, for which it was proposed to obtain power from hydro-electric sources, and when the report closed the question was not ripe for settlement. It had been found necessary, in the Calcutta suburban electrification scheme, because of the heavy expenditure involved, to carry out further investigations, both as to the probable development of traffic in that area and to the estimated cost of the project, in order to ascertain to what extent the introduction of electric traction on the section would be justified financially.

Notes and Memoranda.

A NOTE in the *Engineering News-Record* states that chlorine has been used very successfully at Lakawanna, New York, for the elimination of a gelatinous vegetable growth in the sewage filter beds, which caused considerable trouble. The treatment cost 110·29 dollars per acre with chlorine at 6 cents per pound.

ACCORDING to Professor James Boyle, of Cornell University, "Canada is a country of vast virgin resources. The United States is sometimes spoken of as the richest country in the world, due to the immense progress of both agriculture and industry in that country. The fact is, however, that Canada is a country of larger area and far greater wealth in natural resources per capita. With a balanced development of Canadian resources, coupled with an equally balanced growth of those two great arteries of economic life—transportation and banking—Canada is destined to be the wealthiest country in the world. Already her exports per capita have a value four times those of the United States."

IN the course of an address to the Engineers' Club, Philadelphia, Dr. Henry Arnstein said: "In regard to general cleanliness, such as absence of smoke and disagreeable odours, alcohol has many advantages over gasoline or kerosene as a fuel. The exhaust from an alcohol engine is never clouded with a black or greyish smoke, as is the exhaust of a gasoline or kerosene engine when the combustion of the fuel is incomplete, and it is seldom, if ever, clouded with a bluish smoke when a cylinder oil of too low a fire test is used or an excessive amount supplied, as is so often the case with a gasoline engine. The odours of denatured alcohol and of the exhaust gases from an alcohol engine are also not likely to be as obnoxious as the odours of gasoline and of its products of combustion."

A NEW Dutch fireproof product intended to take the place of porcelain has, says the *Chemical Trade Journal*, been put on the market. Weta-material consists of very fine, uniformly distributed carborundum particles with admixed silicates and metals of the iron series, cobalt and nickel, and sinters, after firing in a porcelain kiln, at about 1400 deg. Cent. A pot is obtainable which, without any glazing, is said to be completely water-tight. A glowing hot Weta crucible can be chilled in cold water without injury. The dark grey crucible can be used for qualitative and quantitative analysis and, on account of its resistance to breakage, is especially adapted for work under very high pressures. Tubes, &c., can also be produced from Weta-material for use in manufacturing plants. Weta-material is manufactured by the Rami-Union in Holland.

TWO-WAY telephone conversation from a moving train was successfully carried on by experts of the Canadian National Railway on May 6th, during a demonstration made on a train on the Allandale branch of the system, travelling at the rate of 40 miles an hour. Mr. W. D. Robb, vice-president in charge of the telephone and telegraph department of the railway, using an ordinary telephone receiver, opened communications with the head office in Toronto, and a complete conversation was maintained for nearly two hours by a number of officials and others. In pursuing their researches the engineers made use of their special test car, which is equipped with a laboratory and has its own electric generator run by a petrol engine. In telephoning from a train the operation is said to be the same as and to involve no more delay than in making an ordinary long-distance call. Work is proceeding with the installation of this equipment on trains running between Toronto and Montreal.

A MESSAGE from Stockholm states that the Swedish engineer and inventor, Dr. Gustaf Dalen, who was the winner of the Nobel Prize for Physics in 1912, has, after long experiments, decided to put on the market a heat accumulating range for household purposes, which is claimed to be almost equal in action to electric ranges but much cheaper to run. The range contains a hot water boiler, two cooking plates and two baking and heating ovens. The message states that the heat is collected in a furnace and accumulated in an insulated metallic substance in contact with the cooking plates and baking oven. The furnace, which is of the slow combustion type, need only be filled once in twenty-four hours; the most suitable fuel being small coke, of which 3 kilos. to 3½ kilos. are consumed every twenty-four hours. The heat in the cooking plates and baking ovens can be automatically regulated and different temperatures can be obtained simultaneously in different parts of the range. The cost of running the new range is much lower than for ordinary ranges, but the price of the standard model which is being manufactured by Husqvarna Vapenfabriks Aktiebolag is still comparatively high—875 kroner. The name of the new invention is the "Aga" furnace.

DISCUSSING the relative merits of gas and electrically heated furnaces, in the *Drop Forger*, Mr. A. R. Page says that for a medium-sized gas furnace as ordinarily used for hardening small steel components, the efficiency is good if it reaches 8 per cent. Electric furnaces of a similar size will possess an efficiency of about 75 per cent. Assume a hypothetical case of a gas furnace which, during a continuous operation of hardening, is consuming 200 cubic feet of gas per hour. This is equivalent to, say, 200 × 550 B.Th.U. of heat, or 110,000 B.Th.U. consumed per hour. If now you replace this gas furnace with an electric furnace, sufficient to produce 110,000 B.Th.U. of heat to effect the same output, one finds that 32 kWh would be necessary. The cost of gas per hour would be about 5d.—the low figure of 2s. per 1000 has been taken, which appertains in Birmingham—while the electric power would cost 2s. 8d.—1d. per kWh. On the face of these figures, it appears ridiculous to suggest the substitution of electrical energy in place of gas. When, however, the respective efficiencies of the furnaces are compared, we find that in the gas furnace the amount of useful heat used is only 8 per cent. of 110,000 B.Th.U., which is 8800 B.Th.U. per hour, while in an electric furnace of 75 per cent. efficiency, it would be necessary to produce only 11,700 B.Th.U., which would be produced by 3·4 kWh. The respective prices therefore are 5d. per hour for the gas furnace and 3·4d. per hour for the electric furnace working under the same conditions.

Miscellanea.

A WOOD-PULP mill with a capacity of 100 tons a day is to be put up at Queensborough, Lulu Island, British Columbia.

THE preliminary surveys for the Pacific Great Eastern Railway, British Columbia, are to be carried out by means of aeroplanes.

A FACTORY for the production of sulphuric acid, fertilisers, weed killers and heavy chemicals, is to be put up at Saskatoon, Saskatchewan.

THE sales of brass pipe in Canada reached the unprecedented total of 76,777,400 lb. in 1928, or almost four times the amount sold in 1922.

AN attempt to grow hemp on a commercial scale is being made in Saskatchewan, and the Provincial Government is assisting in building up the industry.

THE syphon for conducting the Chippawa Creek under the Welland Canal has been completed, and the discharge channel is to be finished in time for the opening of the Canal in 1930.

THE Burlington channel at the port of Hamilton, Ontario, is being widened and deepened, at a cost of 1,500,000 dollars. The work also includes the construction of two new piers and an overhead bridge.

IN connection with the World's Fair Centennial to be held in Chicago in 1933, it is proposed to hold a World Engineering Congress, and the Western Society of Engineers has been selected to take the leadership in the project.

A SWEDISH Industries Fair will be held at Gothenburg from May 26th to June 2nd in the exhibition building of 30,000 square metres floor area, which was originally erected for the engineering section of the Gothenburg Exhibition a few years ago. It is the largest timber structure of its kind in the world.

THE resumption of work on the Ontario Hydro-Electric Power Commission's 54,000 H.P. power development at Alexander Landing, on the Nipigon River, is to take place immediately. This undertaking, which is scheduled for completion in 1931, is stated to involve an expenditure of approximately 6,000,000 dollars.

THE British Empire Steel Corporation has completed plans for the erection at Glace Bay, Nova Scotia, of a modern power plant, costing approximately 2,000,000 dollars, and equipped to supply power to the entire industrial district of Cape Breton, including the Corporation's fifteen collieries and many surface plants.

A BIG new button-making factory is nearing completion at Homerton in which it is hoped that eventually a thousand or so workpeople will find employment. The factory is owned by the British Corosit Button Company, Ltd., and will manufacture largely synthetic "corosit" buttons, hitherto imported from Germany.

THE State coal mines in Bulgaria have decided to erect a complete large briquetting plant, with an hourly output of 30 tons of briquettes, using the pitch process. It is understood that no contracts have yet been placed in regard to the plant. Particulars can probably be obtained through the Bulgarian Consulate in London.

TWO new bridges are to be built over the Back River, Montreal, at an estimated cost of 2,300,000 dollars. The first of these will be of five spans, 1550ft. in length and 70ft. 6in. in width, accommodating six lines of traffic and two sidewalks for pedestrians. It is to be of reinforced concrete. The second, the La Chapelle Bridge, will be of three spans, 1026ft. in length, 52ft. in width, with four traffic lanes and two sidewalks. The piers will be of concrete, while the arches and spans will be of steel.

A CONTRACT has recently been signed at Belgrade between the Jugo-Slavian Government and the French firm Société des Phosphate Tunisiens, whereby the latter company agrees to form a new company, entitled the Société des Forces Hydro-Electriques de Dalmatie, with a capital of 125 million francs. The new company will take over the hydraulic concessions previously owned by the "Sulfid" as well as the exclusive rights to the utilisation of the water powers of the Kerka and Cetina rivers.

SPEAKING at the annual general meeting of the Iron Trades Employers' Insurance Association, Ltd., recently, the Chairman, Sir Frederic Henderson, said:—"We have every year many claims from workmen for further compensation, the original accident in some cases dating back more than twenty years; these men have been employed all that time, and yet considerable expense is caused in dealing with the claims and possibly defending them in court. It would seem as if the existing legislation was operating unfairly and requires amendment, as it encourages the manufacture of unjustifiable claims."

ACCORDING to the Universal Oil Products Company, of Chicago, it is the general consensus of opinion that the expense involved in making motor fuels meet the present specifications of not more than 0·1 per cent. sulphur is not justified. Reduction of the sulphur content of petrol to this standard not only entails enormous expense to the refining industry, but wastes a large quantity of motor fuel. The yearly savings in raising the sulphur content of petrol would be over 50,000,000 dollars. With the object of obtaining definite facts as to the possible corrosive effects of sulphur in fuel for internal combustion engines the company is issuing a questionnaire to users of oil engines.

A MOTOR lifeboat, which has been built by the Royal National Lifeboat Institution for its station at Holyhead, has just left the building yard at Cowes. She is a Barnett lifeboat of the most powerful type in the Institution's fleet, and is 51ft. long, with two 60 H.P. engines. She has a speed of between 8 and 9 knots, and can go to the rescue of vessels anywhere within 75 miles of her station. She has a cabin and carries a searchlight and line-throwing gun. The voyage to Holyhead is 422 miles, and the boat will call at Torbay, Penzance and Milford Haven on her way. This new boat replaces the last of the steam lifeboats in the Institution's fleet, the "James Stevens No. 3," which was withdrawn last autumn, after serving for thirty years.

PULVERISED COAL PLANT AT THE PETERBOROUGH POWER STATION

(For description see page 567)

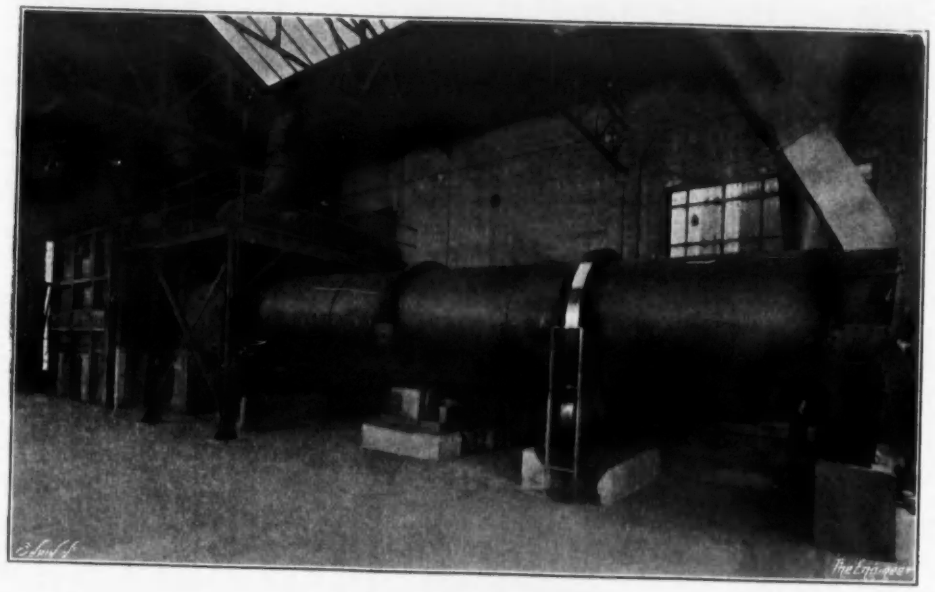


FIG. 9—ROTARY COAL DRYER

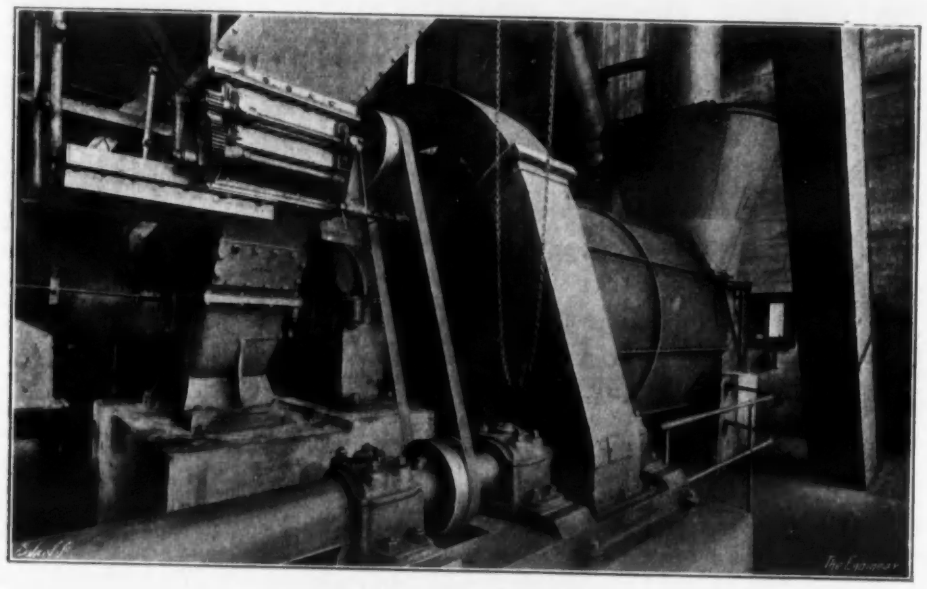


FIG. 10—BALL MILL PULVERISER

FIG. 11—BUNKERS, FEEDERS AND PRIMARY AIR FANS

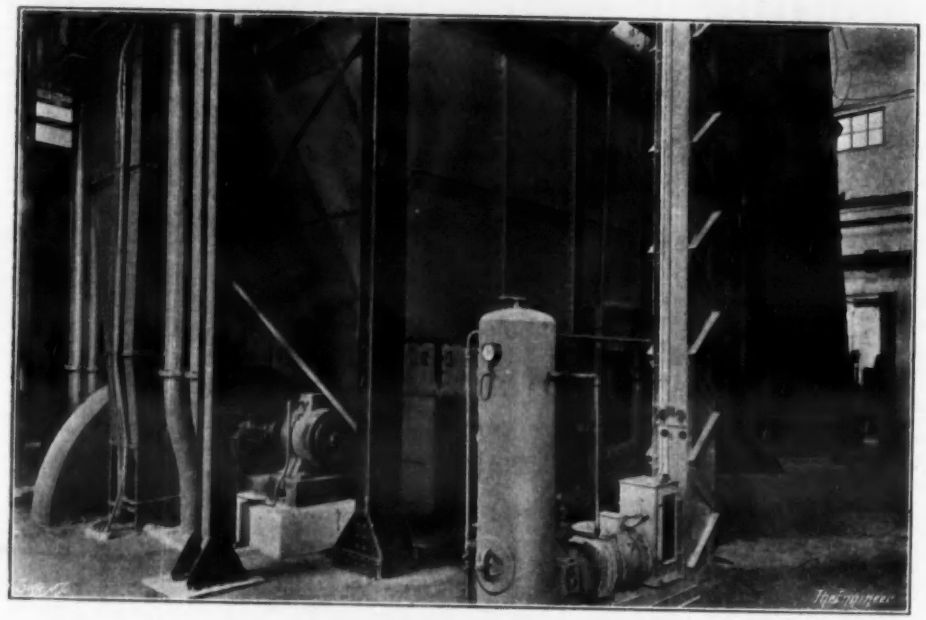
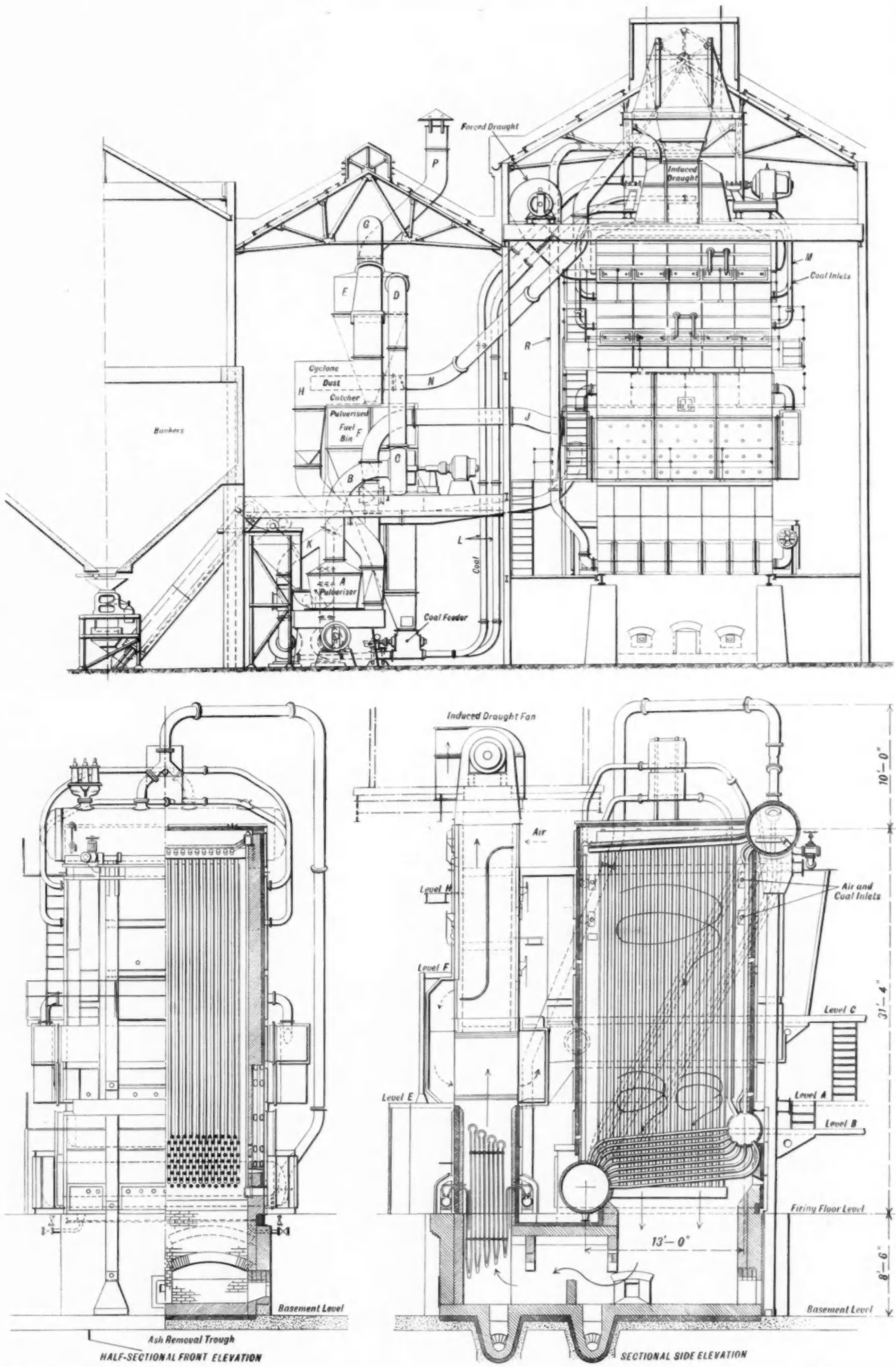


FIG. 12—SECONDARY AIR FAN AND COMPRESSOR

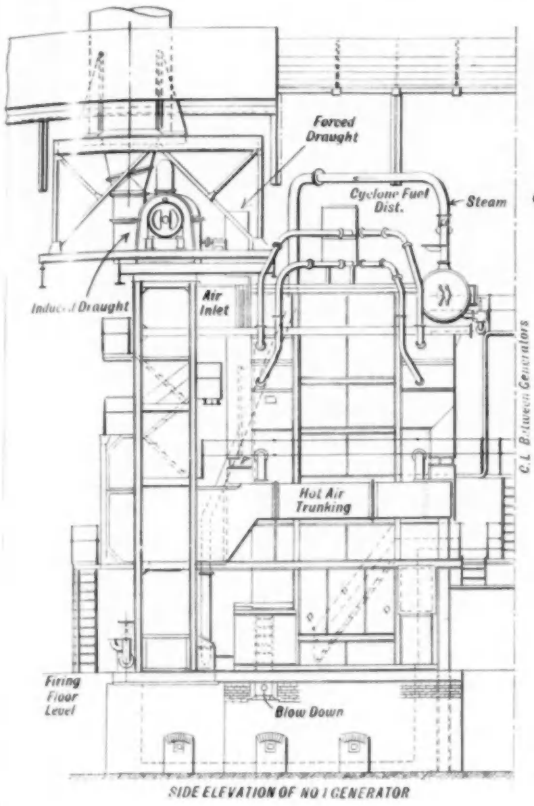
STEAM GENERATOR FOR THE SOUTHW

COMBUSTION STEAM GENERATOR LTD., LON

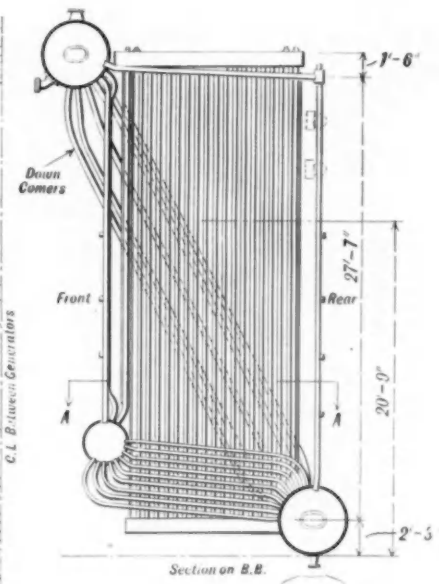


OUTHWICK POWER STATION, BRIGHTON

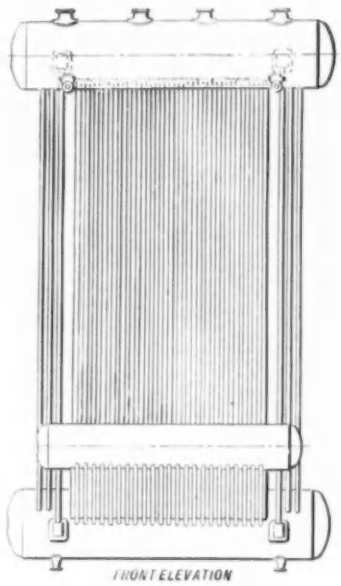
LTD., LONDON AND MANCHESTER, ENGINEERS



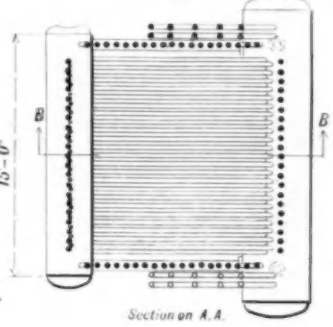
SIDE ELEVATION OF NO 1 GENERATOR



Section on B.B.



FRONT ELEVATION



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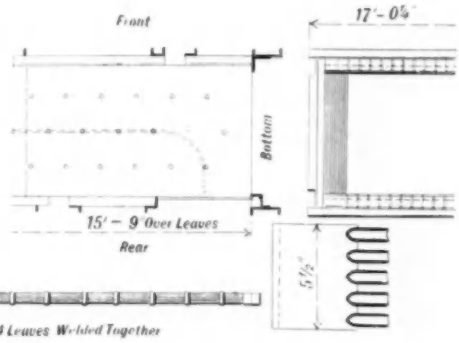
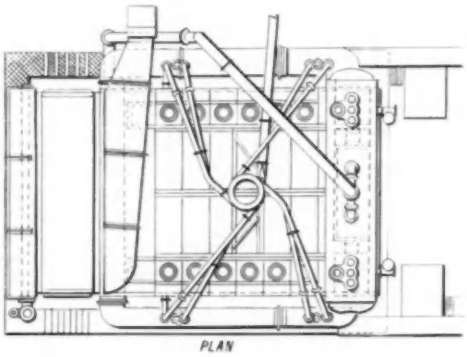
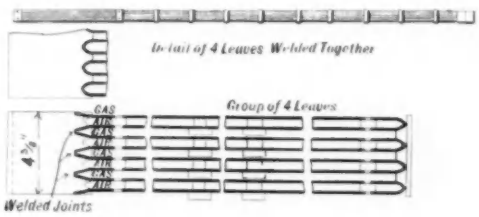
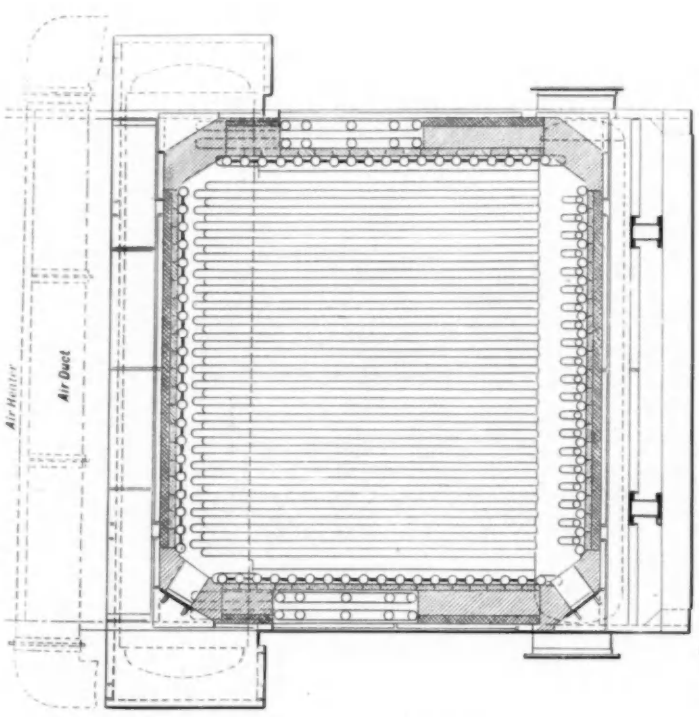




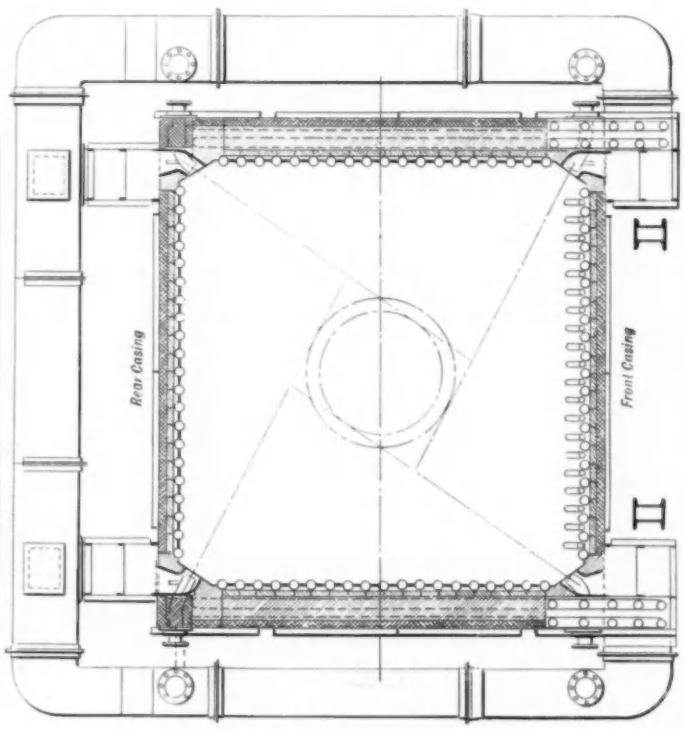
PLAN



DETAILS OF HEATER LEAVES



SECTIONAL PLAN THROUGH ACCESS DOORS



SECTIONAL PLAN THROUGH TOP BURNER BOXES

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TWO-PAGE SUPPLEMENT—STEAM GENERATOR FOR THE SOUTHWICK POWER STATION, BRIGHTON.

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THE ENGINEER.

MAY 24, 1929.

The Economics of Education.

AT the annual conference of the Association of Teachers in Technical Institutions, which opened on Monday last at Liverpool, Mr. A. E. Evans delivered a spirited Presidential Address, the keynote of which may be regarded as the interdependence of education and industry. Mr. Evans is a staunch and avowed utilitarian. "To me," he writes, "the acquisition of knowledge for its own sake is no more laudable than the accumulation of wealth for its own sake. The intellectual snob is as unlovely a specimen of humanity as the grasping miser," and speaking for teachers in technical colleges as a whole, he writes: "Pedants may regard us as one of the lesser breed without the law of a rigid and arid scheme of education detached from the realities of the body, which needs food, shelter, and raiment, but we shall go on with the work which we have taken up; the inculcation of the ideal of service for humanity and the community, and not the acquisition of power, position or education for personal aggrandisement. We do not consciously train for leadership; we train for service. Some with the aptitude for organisation and leadership will be enabled to use their knowledge in a more prominent way than the rest. Others will serve in a humbler capacity, but all, with a realisation that educational means must be adopted to human ends, consciously and without apology."

As some men hate Capital with an "upper-case" C, so Mr. Evans appears to detest Knowledge with a capital K. But we fancy that he has purposely underlined his prejudices in order to galvanise his address, and that, if one discussed the matter quietly with him, it would be found that he could adduce many arguments in favour of a good general education, that he would be able to show that such an education was, in fact, a form of "service," and that his real *bête noir* is the man—no true philosopher—who glories in the parade of his knowledge, or those people who regard with a species of reverence educational degrees and distinctions, whether they are usefully employed or not. Mr. Evans, we suspect, would be amongst the last to deny that a liberal education does, indeed, fit a man to be a good citizen, and hence of greater value to his country and to humanity than an ill-educated or narrowly educated man. But when we come to technical education, we are on different ground. As far as it is concerned, the ability to serve in no vague, but in a very direct way is the first essential. Yet every engineer resembles those little jointed figures cut with a fret saw from thin wood. Viewed from the side they look and behave in their actions more or less like human beings; seen from in front they are nothing but mechanism, a group of levers and rods and narrow straight lines. It is this dual existence which makes a broad education quite as important to the engineer as to those who follow other vocations and professions. And it is it which introduces the problem of the economics of technical education. In the past quite an appreciable number of the shining stars in the engineering firmament took positions of responsibility when they were barely out of their teens. Nowadays, young engineers must remain at school until they are eighteen, spend three years at college and three more in the works before they have any prospect of earning enough to support themselves or of being more serviceable to humanity than the mechanics under whom and with whom they work. Their period of real usefulness has been reduced by four or five years, and those the very years when the mind and the energies are approaching their optimum receptive ability. As far as the practical workshop training is concerned, we regard any reduction of the time allowed as inadvisable, but we venture to ask, with Mr. Evans, if sometimes undue attention is not given to technical college education. We were informed recently by an American professor that the ordinary curriculum of the university to which he belongs is four years, and that a fair number of students prolonged the course to six years. It is probable that ninety per cent. of the students could be taught all that they are ever likely to use profitably in their engineering careers in two years. Hence they devote to the luxury of an advanced college education two to four years which they might devote to service, and during that time they spend money instead of making it. There is as yet no reason whatever to believe that the super-educated man makes a better engineer than the man with a good general education followed by a sound practical engineering course, such as used to be given at Finsbury in two years. We are not speaking of those who have a special call to mathematics or research, but of the ninety per cent. who will have to do for their living the ordinary things of engineering. Taken for all in all, engineering is one of the simplest vocations in the world. It calls for experience and common sense, and apart from rare problems, it seldom demands the higher learning. The inductive method prevails. Everything is tested by experiment and for experimental work keenness of observation, tireless watchfulness, untiring patience and a fruitful imagination are more important than a knowledge of hypotheses and an ability to handle figures by advanced mathematics. The bulk of the profitable inventions in mechanical engineering are the direct outcome of practical experience with machines, and arise from the effort to extend usefulness or efficiency or to remove defects which have been revealed in service or by shop tests. For this work a keen intelligence is the most valuable quality. There are lots and lots of B.Sc.'s who have succeeded as engineers; but many of them, given the opening, would have done just as well without that degree. Unfortunately, it is now often required by employers, who, by so doing, encourage a prolonged education, and, as a result, may cause the curtailment of practical training.

The economic position is an extremely interesting one. We want our young engineers to be serviceable as soon as possible, and we have to select a period of education which will make them efficient; but to extend that education beyond a certain limit is mistaken policy, fostered mainly by those who love education for education's sake. The difficulty is to define the limit. In attempting to do that, we may take a hint, at least, from Mr. Evans' address. We may make it the basis of our consideration that the education must keep "service" in view, and that it is not the purpose of technical colleges to educate for "personal aggrandisement." Most men are pleased to see handles in front of their names; students like to see handles after theirs. But, however useful such suffixes may be to those who are adopting teaching as their vocation, they are in ninety cases or more out of a hundred of little real use to the engineer, and the years which have been devoted to

their acquisition must be regarded as uneconomically spent. Membership of one of the great institutions, based as it is nowadays in part upon the career of the candidate, is a better index to useful qualities than educational degrees.

Modern Electrical Practice.

DEVELOPMENTS in heavy electrical engineering within recent years have taken place along the line of improving and enlarging plant and apparatus, rather than in the direction of revolutionary changes. Generating sets have steadily increased in size, and great improvements have been made in their performance. Much ingenuity has been exercised on the design of various kinds of automatic control gear, whilst largely as the result of the Government's power scheme, British electrical engineers have of late turned their attention to the construction of 132-kV switchgear of large breaking capacity, large transformers with tap-changing gear for varying the voltage whilst the windings are carrying load, and overhead transmission and distribution systems. Improvements have, of course, been made in many kinds of electrical apparatus; but as far as heavy electrical engineering is concerned, nothing has been produced that can be classed as revolutionary, except perhaps the transverter which, as we predicted at the time of its inception, failed to meet the expectations of its originators. One of the most notable achievements of last year was the setting to work of the Parsons 33,000-volt, 25,000-kilowatt turbo-alternator in the Brimsdown power station. The production of this machine, which runs at 3000 revolutions per minute, reflects great credit upon its makers. Even in America nothing quite like it has been produced, although very much larger machines running at 1500 revolutions have been built for 22,000 volts.

Although British electrical engineering owes a good deal to America, where, by reason of natural circumstances, electricity supply has advanced at a rapid pace, the debt has been, on the whole, well paid. Many ideas which originated in this country have been copied in the United States. As pioneers in electrical work, the engineers of this country can easily hold their own. As far as electric motors are concerned, one of the most interesting developments of the times has been the production of squirrel-cage motors having a good starting torque, a development in which British manufacturers have been well to the fore. High starting torques have been made possible by the modification of a very old invention, namely, the double squirrel cage rotor devised by Boucherot, by which it is possible to produce a motor that will easily start against load, yet work efficiently. British electric motor manufacturers have nothing to learn from firms abroad, except perhaps in connection with the design of alternating-current commutator motors, which have never been very popular in this country. The A.C. single-phase traction motor, as employed extensively on the Continent, has never aroused the enthusiasm of British manufacturers, who look with no favour upon A.C. traction. Similarly, up to the present there has been no marked inclination on the part of our electrical firms to build metal-cased power rectifiers. Although this type of rectifier is mainly associated with the name of Brown, Boveri and Co., other continental and American firms are now making it, which proves that the demand for this class of apparatus is increasing. In this country, on the other hand, only glass bulb rectifiers of relatively small outputs per bulb are at present produced. One direction in which British manufacturers appear to be lagging behind is in the manufacture of very high-pressure cables. For many years British-made cables were regarded as the finest in the world, and to a large extent this opinion is still held, but the increasing pressures have introduced new problems, which our cable makers do not appear to have solved. The development of 132-kV cables has far been left to continental and American firms. Both in America and on the Continent, experimental cables suitable for this high pressure have been produced, and are said to be giving satisfactory service.

It is gratifying to find that the demand for cheap electricity in this country, and especially in rural areas, has caused many British electrical engineers to investigate the simple and cheap schemes that are adopted on the Continent, especially in connection with overhead rural distribution. America may have accomplished wonderful things which are worthy of study and the fullest consideration, but it does not follow that American practice is always desirable here. Scientific investigation is what all civilised countries are resorting to, in the hope of finding better and cheaper ways of supplying electricity to the people. The perpetual cry in this country for funds to enable those who are engaged in research to extend their activities and to grapple with many unsolved problems shows how well the importance of rational development is recognised. Without it, there is little prospect of any very revolutionary change or of ever finding the best and most economical methods which in the end may prove to differ considerably from those that now prevail.

Literature.

The Problem of Motor Transport: An Economical Analysis. By CHRISTOPHER T. BRUNNER, M.A. Price 12s. 6d.

Road versus *Rail: The Case for Motor Transport.* By the same Author. Price 2s. 6d. London: Ernest Benn.

THE former and earlier of these two books is an earnest effort to bring the consideration of the question of road transport nearer to the level of the extent to which transport by rail is known and understood. There are probably twenty books on transit by rail to one on carriage by road. That proportion was quite reasonable in pre-war days, but it no longer represents the relative importance of the two rivals, from the point of view of the public. At this time, when politicians are advocating an improvement in the various means of transport, these two books are of unusal interest.

In Mr. Brunner's introduction to his larger work he observes that in the generation which has elapsed since the petrol motor first made its appearance on the roads in any numbers the habits of the ordinary man have been revolutionised; he has learnt to travel and to enjoy travelling, for the sake of travelling, in a way which the railways could never have taught him. As a result the roads have again begun to carry the merchandise and travellers of the country as they did before the building of the railways and canals. The country has been enriched and enlivened by the stream of traffic from the towns, and the towns have benefited by having large tracts of hitherto untouched areas, far removed from railway stations, thrown open to them for playgrounds.

Antiquated legislation, the introduction continues, based on the need to control steam-traction engines, hindered the development of petrol motors, whilst the high speed at which they travelled was another cause of their unpopularity. As late as 1907 Mr. Asquith regarded the motor car as "a luxury which is apt to generate into a nuisance." The early tendency was to limit the use of road vehicles with a view to minimising the damage they caused to the roads; the present tendency is to give them greater freedom with regard to speed and weight, but to subject them to stringent regulation where they are likely to be dangerous to the public safety. "The authorities have shown signs in late years of at last moving in the direction of Macadam's view that the roads should be made fit to carry the traffic without undue damage, and not the traffic limited so as not to unduly damage the roads."

Reference is then made to the establishment of the Road Board under the Finance Act of 1909 and to the accompanying Road Fund, which latter "unfortunately appears to have had another object besides the improvement of the roads; there seems to have been some idea that it should accumulate funds in times of good trade, which should be spent on road improvement schemes in times of trade depression, in order to relieve unemployment." Apart from the creation of the Road Board there was little attempt by the Government to control the road transport industry until, towards the end of the war, it became completely paralysed, and the Government felt that it ought to take some measures to put it on its feet, and the Road Transport Board, as a branch of the Board of Trade, was set up in January, 1918.

Mr. Brunner says that the proposed Ministry of Ways and Communications was the result of the Select Committee on Transport of 1918. That we think is hardly the fact. The Wilson Fox Committee was appointed by the Government, as a result of an agitation amongst the Government's own supporters, less than forty-eight hours after Sir Albert Stanley, then the President of the Board of Trade, had said that no such inquiry was necessary. When the Session of 1918 was almost at a close, the Committee reported, and as there had not been time to formulate a policy, it made recommendations only as to what should not be done, *e.g.*, that the railways should not revert to their former state. The Bill in question had no feature for which the Wilson Fox Committee was responsible; in fact, it safely may be said that it was inspired by the needs of the moment—primarily, the necessity to decide on the future of the railways—then controlled by the Government; and, secondarily, to turn to the best use the able administrators whose main occupation was gone when hostilities ceased. Those administrators, when drafting the Bill, presented some very ambitious schemes, and not only wanted to control every form of transport but the supply of electricity as well.

Mr. Brunner says furthermore that "the Ministry of Ways and Communications Bill was scrapped in favour of the Ministry of Transport Act." As a matter of fact, all the scrapping that was done was to modify the wide powers that were proposed to be given to the Minister. His control over the supply of electricity soon went, and, equally quickly, the proposed Section 4 which gave him power to acquire and work the whole or any part of any railway, light railway, tramway, canal, waterway or inland navigation, harbour or dock undertaking, and to establish, maintain and work transport services by land or water—suggested powers that would appear to warrant our statement that the framers of the Bill presented some very ambitious schemes.

The author proceeds to say that "the Ministry of Transport Act carried the process of centralisation even further than would have been done by the Ministry of Ways and Communications Bill, as it centralised the functions of traffic regulation and co-ordination, highways' standardisation and the making of loans to local authorities, whereas the Ministry of Ways and Communications was to be responsible for little more than traffic regulation and co-ordination." Therein Mr. Brunner is, we believe, wrong. The original Bill allowed the Minister to operate any undertaking just as he liked and to charge as he thought fit, despite any limitations imposed as to the amount of such charges, and even to shut down any service that he thought unprofitable. Parliament, in its wisdom, would not allow such despotism, so tied the Minister down and required him to set up advisory committees and limited the amount that he could spend without the authority of Parliament.

The remainder of the introduction shows the remarkable growth of the motor industry since the war and alludes to the fact that "the roads were far more competitors of the railways than complementary to them; were, in fact, dangerous competitors." The steady extension of the use of commercial goods vehicles is noted and the growth of cars and commercial vehicles from 12,000 manufactured a year in the 1907 Census of Production to 132,000, of a value of £40,000,000, in the 1924 Census, together with an increase in the number of persons employed in their construction and repair from 34,000 in 1907 to 219,000 in 1924 is noted. There are, it is estimated, 40,000 persons employed to-day in the transport, refining and distributing of oil and 60,000 in garages. In one way and another it is estimated that 800,000 persons are directly or indirectly dependent upon the motor transport industry for their livelihood. These are, we admit, very remarkable figures, but as there are 700,000 employed on the railways in the handling of trains and traffic alone, and independently of those in railway-owned and privately-owned railway manufacturing works, they do not yet merit the claim made by the author that "From the point of view of employment provided motor transport must take precedence over rail transport." We do, however, agree that "the tremendous expansion of the motor transport industry since the end of the war has undoubtedly done much to mitigate the post-war trade depression and to find, and, in the main, well paid, employment for large numbers of men who would, otherwise, be without work."

The facts just quoted, it seems to us, are alone sufficient justification for the present work and for its title. The eleven chapters are written in a very informative manner and often with a refreshing frankness.

The smaller and slightly later book deals, as its name indicates, only with the question of road *versus* rail. It was obviously inspired by the concession of road powers to the railway companies, whilst the preface refers to "the tendency for Chancellors of the Exchequer to look on the motor interests as fair game for any increase in taxation, and for Governments to mete out different treatment to the two most important agents in inland transportation—railways and motor transport."

Contrary to the tone of the earlier book this has a grievance against the motor industry. It is that, in contrast with the activities of the railways, the motor industry has been lethargic. The following few sentences from the concluding chapter will show what Mr. Brunner is complaining of:—"As certain sections of it have been both prosperous and unorganised it has had to suffer from the steady imposition of more and more taxation. Had the proceeds of these taxes been utilised for road improvements and the construction of new roads, the saving in time and wear and tear to vehicles might have compensated the industry, but the new taxes, which are millions in excess of anything the motor industry can justly be called upon to pay for the roads, are being spent on very different objects, with the result that the ratepayers are having to pay much more towards the roads than they should, and the proceeds of the taxes are being spent on the Government's fancy schemes." After saying what the railways have achieved, Mr. Brunner proceeds:—"Meanwhile the motor transport industry has done practically nothing. Their case is a very strong one, far stronger than the railways'; but the public do not know about it, and are not very sympathetic because they have

never been told, or had the industries' difficulties explained to them in the same way as those of the railways. . . . If the industry suffered a set-back at this stage it would have an incalculably injurious effect on the new industries and an upsetting effect on the daily habits of almost every person in the country. To avoid this and to protect its own existence on its present level, all interests must combine and present a united front in order to secure fair play and enforce their just demands." This smaller work thus has a claim upon both the sides interested in the question of "Road *versus* Rail."

Repairing Pier Piles with Reinforced Concrete.

IN a paper, entitled "Casing Piles Damaged by Marine Worms in Reinforced Concrete," which he read before the Institution of Structural Engineers on April 11th last, Major F. M. Du-Plat-Taylor, M. Inst. C.E., gave an account of a method of repairing timber piles which has been employed recently in connection with a pier at Swanage.

There are two piers, known respectively as the Commercial and Passenger Piers. The former, which was built in 1859, consists of a masonry jetty at the shore end, 230ft. long by 30ft. wide, and a timber pier stretching from it 500ft. seawards. The timber portion is constructed upon 108 greenheart piles. The depth of water at the pier head at H.W.S.T. is 14ft.

The Passenger Pier, which was built in 1895, is a simple braced structure, carried on 166 single and two double greenheart piles, the walings, braces and decking being partly of greenheart and partly of oak and pitch pine. It is to the north-westward of the old pier, and it starts from the same stone jetty as that mentioned as being at the shore end of the old pier, but at a slightly different angle. With two changes in direction, each through a small angle, this pier stretches seawards for a length of 642ft. 6in. on the centre line, and the depth of water at its outer end is 14ft. The sea floor consists of limestone sand overlying rock, and the piles were in most cases driven down to the latter.

For reasons which are given in the paper, but which need not be repeated here, Swanage is one of the places on the British coasts most favourable to the growth and activity of marine borers and wood-destroying crustacea. It was, doubtless, for that reason that greenheart was chosen for the piles, for that wood, as is well known, besides being one of the hardest and heaviest of timbers, contains a poisonous essential oil which usually renders it immune from any attack by marine borers in British waters.

Curiously enough, the older pier, though it was built some thirty-six years before the other, has sustained but little damage from this cause, whereas in the Passenger Pier there have of recent years been marked evidences of attack by *Limnoria terebrans*, and, to a lesser extent, by *Teredo navalis*. The former, which is not so common as the latter, is a minute crustacean which eats into submerged timber from the outside. The holes made by it are very small, and do not penetrate more than an inch from the surface. They are, however, so close together that they reduce the surface for that depth to the condition of a sponge. The damaged surface is then worn down by the action of the sea, so that a fresh surface is exposed to the attacks of the borer. Ultimately, the whole timber is eaten through. Fortunately, the *Limnoria terebrans* practically confines its activities to timber lying between high and low-water marks; it does not attack wood that is always dry, and rarely touches that which is always submerged. Fortunately, too, for the method of repair which we are about to describe, the maximum rise of tide at Swanage at springs is only 6ft. 6in., the average being 6ft. 1in. The reason why the timbers of the older pier were found to be practically immune, while those of the newer pier suffered so much damage, is thought by Major Du-Plat-Taylor to be that the older structure is in a more exposed position than the latter, and also, possibly, that the timber used was of a better and harder quality.

Examination of the piles of the Passenger Pier revealed the fact that, of the total of 170, 98 were found to be so much damaged as to require immediate attention, 47 were in fair condition and not likely to require repair or renewal for a number of years, while 25 were sound. In addition to the damage to the piles, the whole of the transverse braces, which were also of greenheart, and were fixed just above low water level, had been seriously attacked, as were also the lower ends of the transverse diagonal braces.

A series of photographs, reproduced in the paper, show the serious nature of the damage, which was found to be most severe at approximately mean tide level, where, apparently, very nearly half the bulk of the pile had, in bad cases, been eaten away. The damage was, however, confined to a vertical distance of 6ft. 6in. between high and low water.

Having ascertained the extent of the destruction, it became necessary to consider what would be the best and most economical method of carrying out repairs. As the cost of removing and replacing the damaged piles would have been prohibitive, and as the timber both above and below the seat of the damage was perfectly sound, the obvious course was, Major Du-Plat-Taylor remarks, to strengthen the piles at the damaged part after removing all the perforated wood. It was, therefore, decided to take off the braces in one or two bays at a time, cut away the damaged timber in the piles, and then enclose the weakened portion in a sleeve or casing of reinforced concrete, new braces being subsequently fitted.

The paper goes at considerable length into the designs of concrete sleeves tried, the nature of aggregate finally adopted, and the tests which were made on full-sized timbers, cut away and strengthened in the manner which it was intended to employ for the injured piles. Into the question of those tests, which were carried out in the laboratory of Mr. R. H. Stanger, of Westminster, we do not propose to enter. It will suffice to say that they proved that the proposed method of strengthening would perform perfectly the duty required of it, and it was decided to repair the pier by means of it.

The form of sleeve or casing of concrete which the tests had demonstrated that it was best to adopt is shown in the accompanying engraving, which also shows how the decayed wood was removed, and particulars of the reinforcement. An exhaustive investigation of various aggregates showed that washed and crushed Cornish granite, together with clean, sharp sand from a pit near Poole gave most reliable results. "Lightning" brand aluminous cement, supplied by the Cement Marketing Company, Ltd., was employed, and the granite was crushed to two gauges, ⅝in. and ¼in. The granite and sand were carefully tested for voids, and as a result the following mixture was adopted for the concrete throughout :—

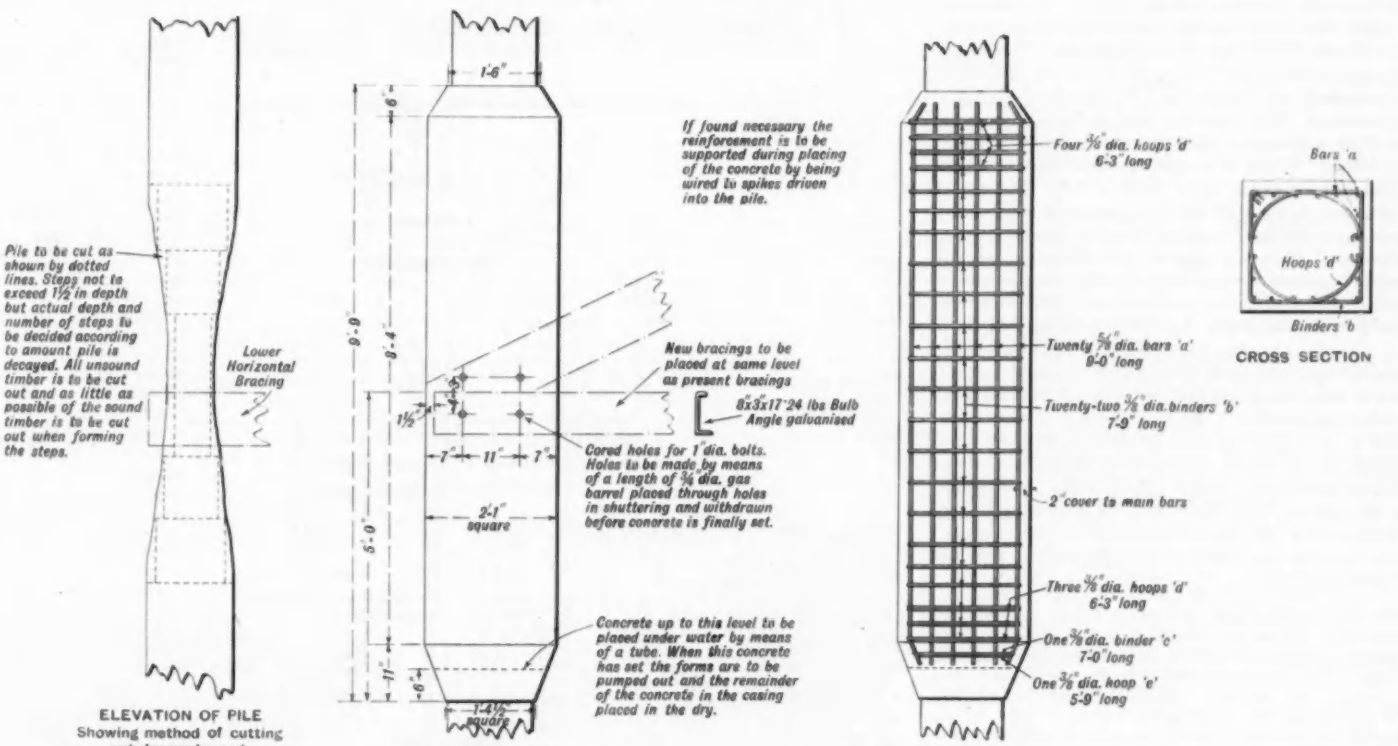
20	cubic feet	⅝in. gauge granite.
10	,,	¼in. gauge granite.
9	,,	sand.
6·5	,,	aluminous cement.

These volumes produced approximately 1 cubic yard of concrete, which was found to be extremely hard and impervious, and to come out of steel moulds with a perfectly smooth surface in which very few pinholes could be detected. The reinforcement was of ordinary 28/32-ton mild steel bars, ⅝in. and ¾in. diameter.

The damaged timber of the piles was cut away in steps, the central portion being reduced from the original 14in. by 14in. to 6in. by 6in. The cover of concrete over the reinforcing bars was 2in., and there was a space of about 3in. between the inside of the bars and the timber of the pile, the casing being 2ft. 1in. square outside. The overall length of the casing was made 9ft. 9in., so that the concrete might come well above H.W.S.T. and well below L.W.S.T.

It might, remarks Major Du-Plat-Taylor, have been possible to affix the casings by tide work—or, at any rate, that portion of them which was above low water—but actually it was decided to employ divers. In the design of casing finally adopted, the "cage" or reinforcement was held in position by the contact of the ends of the bars bent inwards, so as just to touch the timber—without any physical union—at each end, while, elsewhere, it was held in position by short wooden struts, which were removed as concreting progressed. In addition to the square binders—see *b* in the engraving—a series of four ⅝in. diameter circular hoops—*d* in the engraving—were inserted at each end.

The moulds for the casings, which were of steel, were constructed in sections, so as to be easily lowered into position, the sections being bolted together with tarred felt insertion, so as to form water-tight joints. The two bottom sections were made tapered so as to clamp on to the pile below. Considerable difficulty was experienced in making a water-tight joint between the tapered or "hopper bottomed" sections of the moulds and the piles, owing to variation in size of the latter, but it was surmounted by placing wood strips on the piles and packing the interstices with clay. Plain concrete was then poured through a tube under water into the bottom of the mould to a depth of 6in., as seen in the engraving. When that was set, the casings were pumped out and the main body of the concrete poured in and carefully rammed.


Pile to be cut as shown by dotted lines. Steps not to exceed 1½ in depth but actual depth and number of steps to be decided according to amount pile is decayed. All unsound timber is to be cut out and as little as possible of the sound timber is to be cut out when forming the steps.
Lower Horizontal Bracing
ELEVATION OF PILE
Showing method of cutting out decayed wood.
1'-6"
6"
9'-0"
9'-4"
5'-0"
11"
6"
1½"
7" 11" 7"
2'-1" square
1'-4½" square
If found necessary the reinforcement is to be supported during placing of the concrete by being wired to spikes driven into the pile.
New bracings to be placed at same level as present bracings
8x3x17·24 lbs Bulb Angle galvanised
Cored holes for 1" dia. bolts. Holes to be made by means of a length of ¾ dia. gas barrel placed through holes in shuttering and withdrawn before concrete is finally set.
Concrete up to this level to be placed under water by means of a tube. When this concrete has set the forms are to be pumped out and the remainder of the concrete in the casing placed in the dry.
ELEVATION OF CONCRETE CASING
Four ⅝" dia. hoops 'd' 6-3" long
Twenty ⅝" dia. bars 'a' 9'-0" long
Twenty-two ⅝" dia. binders 'b' 7-9" long
2" cover to main bars
Three ⅝" dia. hoops 'd' 6-3" long
One ⅝" dia. binder 'c' 7-0" long
One ⅝" dia. hoop 'e' 5'-9" long
DETAIL OF REINFORCEMENT TO CASING
Bars 'a'
Hoops 'd'
Binders 'b'
CROSS SECTION

ARRANGEMENT OF REINFORCED CONCRETE CASING FOR INJURED TIMBER PILES

The moulds were stripped from the casings not less than twenty-four hours after the concrete had been deposited.

The paper also describes the replacing of the bracings, the fixing of fender piles and special spring fenders and various other works in connection with the repair of the pier.

Steam Generators at Brighton.

NOTWITHSTANDING the variety of boilers which meet the requirements of modern power station practice, the increasing severity of the conditions of service is gradually emphasising certain principles necessary to successful design. The call for outputs running into hundreds of thousands of pounds of steam per hour from single units demands high rates of evaporation if dimensions and capital costs are to be kept to reasonable figures. These high ratings in their turn diminish the importance of the water that can be stored in the boiler drums, for it is not practicable to increase the drum capacity in the same ratio as the heating surface. The higher pressures now coming into use tend to a still further decrease in water capacity if only on account of the problems connected with the manufacture of large high-pressure drums. Evolution is therefore taking place in the direction of more and more extensive tube systems, with only such drum dimensions as are necessary for suitably connecting the tubes. So far as the boiler as a whole is concerned, the "flash" or "Perkins" type is being approached, with both feed and firing closely regulated in accordance with the momentary demand for steam. It is, however, in connection with the furnaces that evolution is most active. The use of preheated air with efficient conditions of combustion leads to very high furnace temperatures, while considerations of space require the liberation of the greatest practicable amount of heat per cubic foot of furnace volume. The immense brick-walled furnace chambers of the early days of powdered fuel firing are already passing into history, flame-turbulence permitting a great reduction in dimensions and water-cooled walls avoiding the serious troubles which the brickwork entailed. The employment of any brickwork at all in the furnaces is indeed now being questioned, for the direct transmission of the heat of the fire by radiation to water-cooled walls on all sides, as is done in locomotive and other internally-fired boilers, makes for the highest possible rates of evaporation and so minimises the heating surface required for a given duty.

A very brief review of modern boiler practice will show the existence of all the tendencies outlined above, though the extent to which each is developed depends largely upon its applicability to any particular type of boiler. In designing the steam generator which we are about to describe, its inventor, Mr. W. R. Wood, of the Combustion Steam Generator Company, Ltd., of Aldwych House, London, W.C. 2, was not limited by the desire of merely improving any existing type, but set himself rather the problem of combining such characteristics as were known to be desirable and attainable, in the light of a lifetime's experience of boiler-plant in general. Pulverised fuel firing was decided on, and in connection with it, also, the complications and defects of the earlier systems were eliminated in favour of the relative simplicity which is always attainable with good design. The first steam generator constructed on Mr. Wood's principles was installed at Messrs. Taylor Brothers Steelworks, Trafford Park, Manchester, in the year 1924. This plant, which had a rated capacity of 75,000 lb. of steam per hour at 350 lb. pressure, and 650 deg. to 675 deg. Fah. temperature, was so successful that Mr. John Christie, engineer and manager of the Brighton Corporation Electricity Department, realised the possibilities of the type and placed an order for two large units to be installed in the Southwick Power Station. These units have now been in regular service for several months, and by the courtesy of Mr. Christie we have been permitted to inspect the installation at work and to describe the system with reference to this particular plant.

The two generators at Brighton stand side by side in the boiler-house, behind each being the pulverising plant pertaining to it. Each generator is designed to produce at normal load, 100,000 lb. of steam per hour at a pressure of 350 lb. per square inch and a temperature of 610 deg. Fah., with an overload capacity of 125,000 lb. per hour. Owing to the present circumstances of the station, however, the boilers are working actually at 230 lb. pressure. The general arrangement of one unit, complete with pulverising plant, is illustrated on the left in to-day's Supplement, in which views in elevation of the boiler and pulverising plant, as they would be seen from the direction of the boiler-house, and a plan of the boiler, are also given. Reference to the general arrangement will show that the raw coal descending from the bunkers passes first through an Avery automatic weighing machine, and is then raised by a small bucket elevator to a hopper which supplies the pulveriser A. The latter is of the Raymond pendulum arm type with a capacity of 6 tons per hour. It is driven by a direct-current motor of 80 B.H.P. The mixture of coal dust and air from the pulveriser is raised through the pipe B by means of an exhauster fan C, and delivered by the pipe D to the cyclone separator E. Here the coal dust is separated from the air and passes centrally downwards into the pulverised fuel bin F. The air returns to the pulveriser by way of the pipe G and the dust catcher H. Before it reaches the pulveriser, however, it is mixed with hot air brought from the boiler by means of the pipe J. The temperature of this air is about 600 deg. Fah., and it is quite hot enough to dry the coal effectively in the pulveriser, so that any coal with ordinary moisture content can be ground without the need of previous drying in a special apparatus. An independent supply of hot air is brought from the boiler by the pipe K. The air is delivered by a pair of 30in. Sirocco fans to the feeders under a pressure of about 6in. w.g. and carries the fuel up the pipes L to a fuel distributor

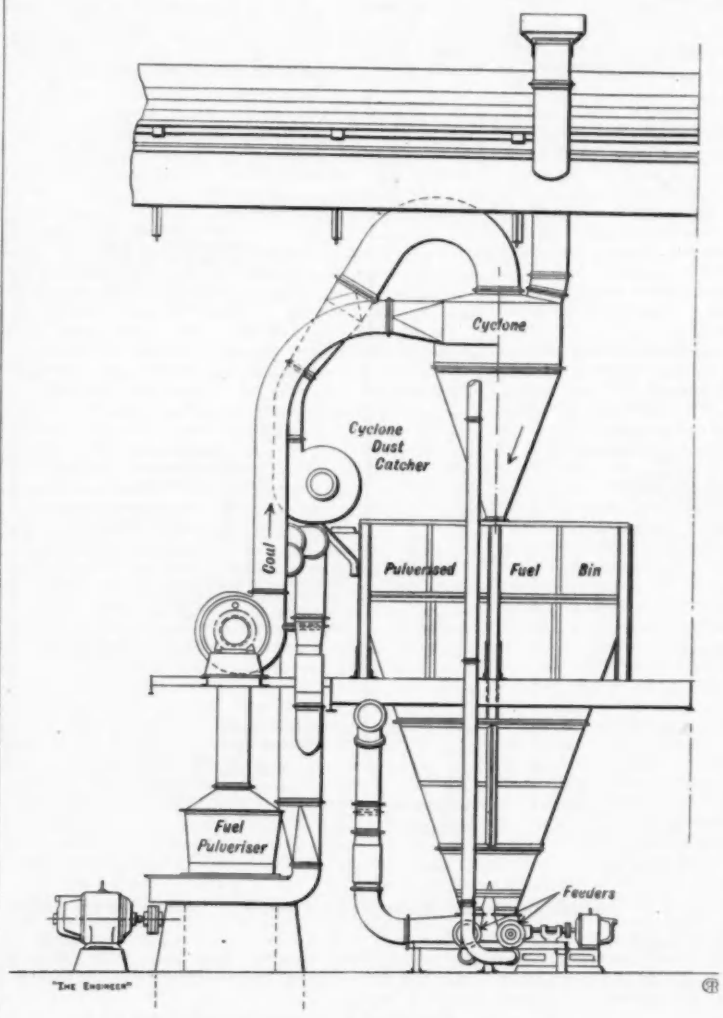


FIG. 1—ARRANGEMENT OF POWDERED FUEL PLANT

at the top of the boiler. This distributor, which is of the cyclone type, will best be described in connection with the drawings of the boiler. For the moment it will suffice to say that the pipes M are those taking the fuel from the distributor to the burners; N and P are vent pipes from the dust-catcher and cyclone separator respectively; and R is the main steam pipe from the boiler. The feeding arrangements, it will be noted, are in duplicate, and cross-connections from the other plant add a further measure of security and flexibility of operation.

The greatest interest of the plant lies, we think, in the design of the steam generator itself, which is illustrated independently of its setting on the right-hand side of the Supplement. It is, as we have already indicated, a sort of rectangular box closed by tube surfaces at the top, bottom and sides. There are two main drums, each 3ft. 11½in. internal diameter, which run parallel to each other, one across the top of the boiler at one side and the other across the lower diagonal corner. Attached to each drum, near the ends, is a pair of rectangular headers. Each header of the upper drum is connected to that of the lower drum immediately beneath it by a series of 4in. Murray fin tubes, thus forming two vertical side walls for the furnace. A third drum, 2ft. 7½in. diameter, is situated under the upper drum but nearly at the bottom of the boiler. These two drums are connected by 3in. and 4in. tubes alternating with each other, the 3in. tubes being slightly bent at the ends, so that although the latter are staggered sufficiently for the sake of the strength of the drums, the tubes lie in close juxtaposition throughout almost their entire length. They thus form a complete water-cooled wall enclosing what may be called the front of the boiler. Opposite them at the back is a fourth vertical water-cooled wall composed of Murray fin tubes connecting the bottom drum with a rectangular header at the top. This header is connected to the upper drum on the front of the boiler by a layer of almost horizontal tubes forming the roof of the furnace. At the bottom a bank of curved tubes connecting the two lower drums forms a water screen to separate the furnace from the ashpit beneath. A definite circulation of the water is assured by sets of downcomer tubes running diagonally down the two sides of the furnace and connecting the ends of the upper and lower main drums. These downcomers are outside the water-walls and in a comparatively cool place. The circulation in all four sides of the furnace is upwards, the water returning from the upper drum by the diagonal downcomers alone to the bottom main drum, whence it is distributed directly to the rear wall and roof; by means of the headers to the side walls, and through the water screen and small drum to the front wall.

An examination of the design will show how well the object of a completely water-cooled furnace has been obtained without the sacrifice of any practical requirement. The interiors of all tubes can be cleaned with as much ease as those of an ordinary boiler. The drums give access to both ends of the down-comers, the water screen tubes and the tubes forming the front wall, also to one end of the upper screen tubes, and those constituting the rear wall. The other ends of these tubes, and both ends of the tubes of the two side walls are accessible by the removal of caps on the respective headers. Any tube, again, which may be found defective can be cut out and replaced with no more trouble than is experienced with boilers of more usual design. Finally, the whole construction is free to expand as it will without undue stresses. The boiler is supported by the top drum and kept in a vertical position merely by the side pressure of the small lower drum against the supporting structure. Such expansion as takes place is, therefore, uniformly downwards, the equality of temperature of the four walls preventing the racking stresses unavoidable in designs in which rigidly connected rows of straight tubes are unequally heated.

The arrangement of the boiler in its setting is illustrated in the Supplement, the sectional side elevation showing clearly the method of support just referred to. The four walls of the furnace, as will be seen, are backed by insulating bricks behind the tubes, and the roof tubes are covered in a similar manner. Space is left in the brickwork of the two side walls for the descent of the downcomers from the top to the bottom drum. The furnace is fired by eight burners, situated at the corners between the walls, as shown. The burners are divided into two independent sets of four each, the burners of each set being on the same level and arranged to direct the flame tangentially to an imaginary circle, as indicated in the sectional plan through top burner boxes. Each set of burners is fed from its own distributor and coal feeder, quite independently of the other set so that either set can be started or stopped at will. The tangential arrangement of the burners is an essential feature of the design. It causes a violent horizontal swirling motion of the flame, which not only provides the turbulence now recognised as so necessary to rapid and complete combustion, but maintains a uniform temperature at all parts of the combustion zone. The water walls, moreover, are continually swept by a fast moving body of incandescent gas, and burning fuel dust, and are therefore exposed to the best conditions for receiving heat rapidly by conduction. That the contents of the furnace are really in a state of rapid horizontal circulation when the boiler is at work, is evident by a glance at the interior

of the furnace through one of the sight holes. The burning fuel goes round and round till combustion is complete, the flaming gas having a fairly sharply defined lower surface, which rises or falls with the load on the boiler. Below this incandescent zone there is no burning, but merely gases of combustion which descend through the water screen beneath and deposit their entrained ash, chilled by its passage through the water screen, in the ashpit below. The secondary air, which completes the combustion, is admitted, like the fuel, at the four corners of the furnace, and has a similar tangential motion. It is preheated to about 540 deg. Fah. by the waste gases leaving the superheater, and enters a rectangular trunk surrounding the boiler, whence it is delivered through the curved pipes shown in the half sectional front elevation at about the mid-height of the furnace.

At this point we may revert to the coal-feeding

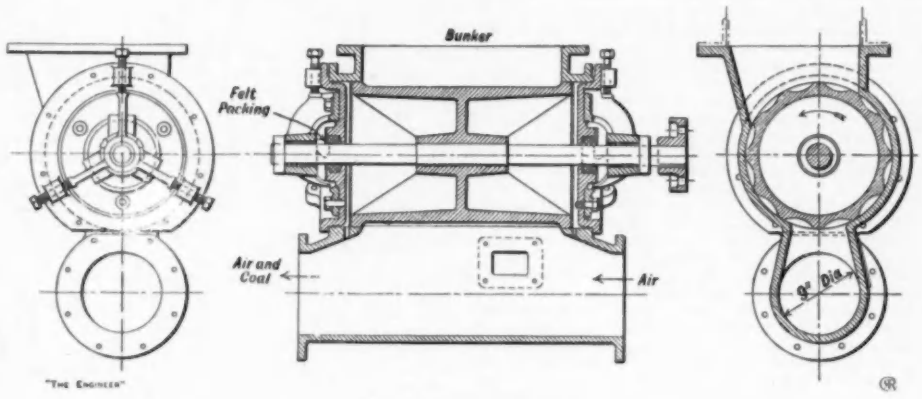


FIG. 2—COAL FEEDER

arrangements. The position of the two feeders underneath the pulverised fuel hopper is shown in Fig. 1, and details of the design of a feeder are given in Fig. 2. The drawings hardly need any explanation. A fluted roller, 16in. diameter, is rotated at a slow but variable speed in a cylindrical casing. The powdered fuel is entrained by the flutes and delivered into the pipe beneath, whence it is swept forward by the primary air and carried up to the cyclone distributor served by that feeder. One of these distributors, of which there are two superposed at the top of the boiler, is illustrated in Fig. 3, in which it is seen upside down on the ground. It is of welded sheet steel construction, manufactured by W. G. Allen and Sons, Ltd., of Tipton, Staffs. The fuel and primary air enter tangentially by the large branch at a high speed. They swirl round the interior

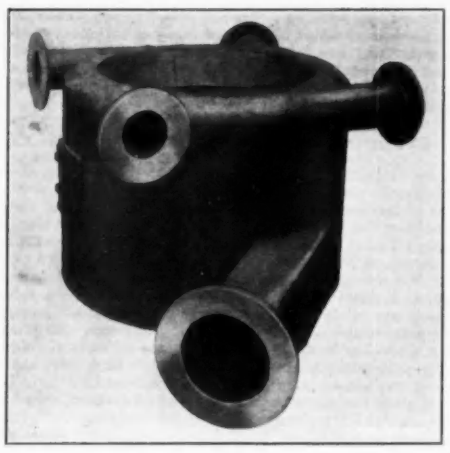


FIG. 3—DISTRIBUTOR

of the chamber, and escape in even streams by the four smaller branches, each of which serves its own burner.

The products of combustion, having deposited their ash in the form of dust in the chambers beneath the boiler, whence it is washed away by the water sluices shown in the sectional side elevation in the Supplement, pass upwards first through a superheater and then through an air heater. The necessary draught is provided by a 40in. Sirocco fan, driven by a 56 H.P. motor. The fan is capable of giving a draught of 2·75in., when handling 58,000 cubic feet of gases per minute. The arrangement of the superheater is clearly shown in the same drawing. The tube elements lie parallel to the flow of the gases, and the headers are arranged horizontally outside the flue on the firing floor level, where they are easily accessible. The air heater is a rectangular structure nearly 16ft. high, placed directly above the superheater. The gases pass vertically upward through it, and the incoming air flows downwards, being delivered to its upper end at one side, under a pressure of 6in. w.g. by a 60 H.P. Sirocco fan. The air leaves at the opposite side of the lower end and passes into the hot air duct round the boiler, whence it is taken to serve as primary and secondary air for combustion. A photograph of the air heater is reproduced in Fig. 4, and details of its construction are given in the Supplement. It is, as will be seen, a fine piece of work. The total heating surface is 24,843 square feet. This is made up of 338 plates 12 B.W.G. thick, 15ft. 9in. long by 4ft. 8in. wide, welded together at the edges in such a way as to form alternate passages for the gas and air between them. The plates, before being used, were annealed and hydraulically flattened. Distance pieces, 1¼in. diameter at 15in. centres, are welded between them to maintain the spacing, and curved deflectors are attached in the same way to guide the air. The edges of the plates are curved into juxtaposition before welding, so as to form streamline entrances and exits for the air and gases. The plates are made up in sets of four or five leaves, and these are welded together on site to form the complete structure.

A study of the Wood steam generator as a whole cannot fail to leave the impression that it is a piece of sound engineering. It is the outcome of the application of an original mind to the problem of steam raising under modern conditions, and though ingenuity is everywhere evident, there is no departure from the features which experience has shown to be necessary in boiler practice. Indeed, it is the wholehearted application of accepted principles, notably those of the maximum utilisation of radiant heat, the absence of refractories in the furnace, and the

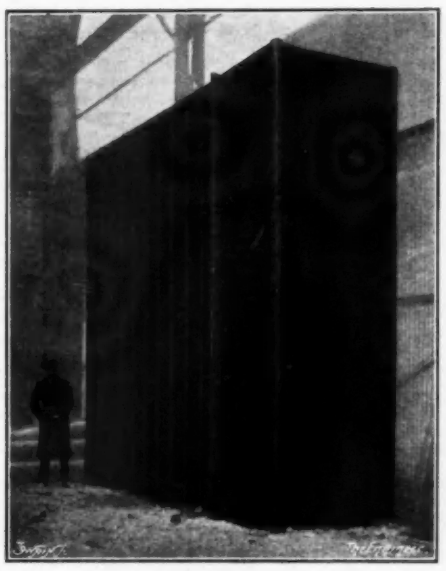


FIG. 4—AIR HEATER

turbulence of the burning gases, which justifies the claim of the generator to rank as a noteworthy advance in design. The thoroughness of the utilisation of radiant heat is shown by the fact that the only tubes in which conduction is depended upon are those forming the water screen through which the gases pass out of the furnace. In working, the boiler is extraordinarily responsive to fluctuations in the demand for steam. At Brighton the control board is equipped with meters and gauges for enabling the operation to be minutely watched, and it is striking to see the instant and rapid increase in the steam output when the feeders are speeded up. The needle of the steam meter moves so fast that the boiler gets away, as was remarked, "like a motor car accelerates," the output going up at the rate of something like 500 lb. per second, whilst perfect combustion is maintained. Mr. Wood informs us that at normal capacity 83 per cent. of the heat is absorbed by radiation and only 17 per cent. by convection.

We hope to publish official tests of the plant as soon as they are available, but may now remark that an uptake temperature of 320 deg. Fah. normal load, without economisers, and with a CO_2 reading of 12 or 13 per cent., leave little doubt that the generator will do all that is expected of it. The plant was supplied by the Combustion Steam Generator, Ltd., of Aldwych House, Kingsway, London, W.C. 2.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

132,000-VOLT CABLES.

SIR,—In recent correspondence on the Battersea station it seems that the risks of employing 132,000-volt cables are quite unduly magnified. To anybody who has got the least foresight, cables at 132,000 volts must come, as surely as steam pressures and hydraulic pressures—and now even town gas pressures—must go up; and the sooner we get experience with them the better.

What are the risks? The Pirelli cable in Italy has been working continuously during the last eight years; two 90,000 kVA transmissions—one in New York and one in Chicago—have now been working for practically two years; and I have private information which shows that American cable manufacturers are tendering for, and guaranteeing performance of, other large installations in the U.S.A. with these cables. Indeed, so confident are they that one of the very foremost of them is, to my own knowledge, ready to put down such cables in London under a two-year guarantee.

However, let us consider the risks. According to *Engineering's* estimate for Battersea, it will cost £2,700,000 to run perhaps 15 miles down the river, or, say, £180,000 per mile of route. Now, the 66,000-volt cables cannot cost more than £3000 per single-core cable per mile, so there must be at least sixty cables—twenty circuits, each a complete unit.

I suppose I shall hardly be believed when I say that 300,000 kW could be transmitted by twelve 132,000-volt pressure oil-filled cables costing, on reliable information in my possession direct from the manufacturers, not greatly over £1,000,000, even for 15 miles. I submit that 10 miles, however, is amply sufficient; it would carry us down past many possible sites.

Whether this figure be accepted or not, I am prepared to demonstrate, in the right quarters, that twelve cables would do the job with the amplest possible margin for spares.

Now, if a 66,000-volt cable breaks down—and they will only go down one at a time—we have fifty-seven cables still in parallel to carry the load. Only ten years ago a certain prominent engineer was criticised for being ultra-conservative because he preferred ten small generating sets in his station to, say, three large ones and one spare. But twenty sets; how ridiculous!

Now take the 132,000-volt side. In the above twelve cables there is a provision equivalent to two large generating sets and four full-sized spare or standby sets. This may not be clear in certain quarters, but let it stand; I can justify it. What generating station engineer would not be delighted if he could have such a standby equipment, and at such a relatively low cost.

The fact that the New York and Chicago installations have now been running without any hitch for nearly two years, under strenuous conditions as regards load, is conclusive proof that they are going to stand, that nothing short of the perforation of the lead sheathing or the gradual failure of the dielectric can put them permanently out of working.

In the early days of 33,000-volt cables the mistake was made of not testing them under heavy overloads. We have learnt our lesson on that point and it will not occur again.

On the question of any radical changes developing with time in the dielectric—apart from loading—that is settled for us by the eight years of experience on the aforesaid Italian line.

If we save £1,700,000 by using pressure oil-filled cables, and if—to assume the worst case conceivable—these began to go wrong after eight years, and if we had to replace the whole lot bit by bit within twelve years (total), we have still that £1,700,000—plus the saved interest and depreciation over eight years—with which to buy two complete sets of new cables, extending the equivalent life to thirty-six years at least. Who is going to say that 66,000-volt plain impregnated cables will last longer than thirty-six years?

Again, quite apart from Battersea we must face the need for cross linking in London. They are already doing it in New York. Only a fortnight ago came a report that, owing to a heavy thunderstorm, the load at one part of New York went up suddenly by 300,000 kW. This cannot be met with 66,000-volt cables without great expense, owing to the congestion of our streets and the annual losses in the cables. What again in relieved street congestion would be effected by reducing the sixty cables to twelve, spread over four different routes.

It seems to be pretty obvious that our British cable manufacturers are now discountenancing the employment of 132,000-volt cables. This, however, is a dangerous proceeding. One of these days we shall have one of the more enterprising American cable companies—in fact, they are ready now—actually offering to lay and guarantee in London pressure oil-filled cables at a cost not much more than one-third of that with 66,000-volt cables.

Are we going to hamper British industry and lose annually hundreds of thousands of pounds—it will come to that shortly—waiting for these cables to have had two or three years' more experience—at somebody else's expense—while meanwhile American and Italian manufacturers reap the reward of that enterprise which used to be considered an exclusively British possession ?

In conclusion, I commend the extract from Sir John Snell's statement before the Parliamentary Committee in 1927, quoted in the *Electrical Times* of May 16th, 1929, to your readers, as showing what we have got to face in the way of increased power loads in the West End of London. What if the E.D.A. should succeed in its efforts to increase the loads ? Even Sir John Snell's estimates might then be upset, and my case would be all the stronger.

This letter is neither a plea for or against shifting the Battersea station ; it is solely a plea for giving pressure oil-filled cables a thorough trial at as early a date as possible. Reference has been made to Battersea merely as a convenient exemplification of the issues involved.

As I can claim to be the only engineer who has had made and successfully tested, up to 720,000 volts, at his own expense, a super-tension cable intended for 150,000-volt working, I hope I may be considered as entitled to say something on this subject. A. M. TAYLOR,

Birmingham, May 17th. Major.

INVENTION.

SIR,—The brief account which you gave in your issue of May 3rd of Mr. Turnbull's discourse on "Invention" to the Institution of Electrical Engineers indicates that even among accredited engineers the true significance of the term invention is not properly understood ; and a long experience of the ideas which are offered to the Patent Office as being "inventions" that should be protected against infringement supports this contention.

There is a vast difference between a real invention and a design, and it would seem that Mr. Turnbull is rather fostering the latter category. Given a definite requirement, any real engineer can devise a means of its provision, and although one solution may be better than another, it cannot be said that either one or the other is an invention. With few exceptions it may be said that the real inspiration came from the man who indicated the requirement. There are the classic examples of the hair curler and the ball stopper for the mineral water bottle, as inspirations which have brought good recompense to their inventors ; but, as Mr. Turnbull suggests, there is far too great a tendency in engineering circles merely to re-design an existing mechanism and not to view the problem on broad principles untrammelled by precedent.

I have in my mind several examples, among which a countryside butcher threw a completely new light on a pumping problem, and another man who—I hope he will not read this—might be described as a painter, showed a firm making three-ply wood how to reduce the time of their operations by 50 per cent.

Designers can, of course, be assisted by such a scheme as Mr. Turnbull suggests, but it would tend rather towards the destruction of their inventive faculty, if they have any. Inventions are born, not manufactured, and the only way of increasing their number is by the interchange of thought among people of the most diverse occupations.

Walton, May 18th. THE BOATMAN.

THE STABILOGRAPH.

SIR,—I should like to express to you my appreciation of the article describing the "Stabilograph," appearing in your issue of May 3rd.

I would like to emphasise one important property of the instrument which should make it of considerable practical and economical value to shipbuilders, who nowadays wish to satisfy themselves and their clients as to a ship's stability by actually inclining her. An actual experience will probably best serve to illustrate the point.

An inclining experiment was being carried out on a large cargo vessel having a metacentric height in the light condition of rather more than 12ft. In order to keep the amount of inclining ballast to a minimum and to secure a satisfactory measure of the angle of heel, plumb bobs 50ft. long were used. Fortunately it was possible to use pendulums of this length ; fortunately, too, the weather and water conditions were ideal—an absolute calm. The measurements of the heel taken from the "Stabilograph" record agreed identically with the measurements by the pendulums. The instrument was placed in a bridge deck cabin and it was a source of some pleasure to me to see three draughtsmen—there was a fourth in charge of the experiment—toiling up and down hold ladders, whilst I was sitting comfortably by the instrument getting all the information they were getting with great effort. I could have taken on the duties of the charge hand myself.

Had there been any motion on the ship it would have been extremely difficult to obtain satisfactory readings with the long pendulums, whilst by means of the graphic record the true mean inclination of the vessel could be readily measured.

Generally speaking, on every ship inclined using this or similar instruments one observer only is necessary, and probably only one half of the weight need be used for inclining in order to secure the same accuracy. There is not only a great saving in the total cost of the experiment, but increased satisfaction and confidence in the results obtained. T. B. ABELL.

The University, Liverpool, May 8th.

The Question of Wagons.

IN the following notes, issued by Coal Industry Publications, the facts about coal wagons are clearly and concisely stated. We may remind our readers that the whole subject is under consideration by a committee under the Chairmanship of Sir Arthur Duckham.

On the North-East Coast about 88 per cent., and in Scotland about 60 per cent., of the coal carried is transported in railway-owned wagons. There are, however, between 500,000 and 600,000 privately-owned wagons, and the ownership is divided between colliery companies, coal factors and merchants, wagon finance companies and wagon-hiring companies.

Over 40 per cent. of these privately-owned wagons are already pooled in nine pools, and the tendency towards pooling is spreading with the development of co-ordination and of marketing organisations within the industry. It is submitted that this is the right line of development, since it combines any advantage of a common user with those of ownership by those who use the wagons.

The maximum economy estimated before the Samuel Commission as possible from the abolition of private ownership was one penny per ton of coal carried, and the representative of the railways who put it forward admitted that it would probably be much less. Other expert evidence put the maximum saving as regards coal wagons in the neighbourhood of one farthing per ton in view of the fact that the average load of a coal wagon is over 9 tons, as compared with less than 3 tons for general merchandise.

It must not be forgotten that one very important factor in relation to colliery output is the necessity for the storage of coal in wagons (which is by far the most efficient and economical method of storing) in order to avoid irregularity of working with consequent higher costs, and periodical short time. The railway companies have declared definitely that in their hands the wagons could not be used for this purpose. The imposition of heavy demurrage charges would be a very serious additional burden upon the industry.

The possible use of coal wagons for general merchandise is often much exaggerated. In South Wales, for instance, the hundred thousand or more privately-owned wagons used in conveying coal from pit to port could not be used to any extent in general traffic without serious detriment to the working of the collieries. On the North-East Coast, where the wagons are railway-owned, they pass straight back from port to pit as in South Wales.

The representative of the Railway Companies, in his evidence before the Samuel Commission, admitted that any saving that might result from a reduction in shunting consequent upon common ownership might be more than wiped out by the disadvantage of not having the wagons available for storage of coal by the owners, and that no reduction in railway rates could be promised if the change were made.

The real danger in dealing with a question of this kind lies in failure to observe a true sense of perspective in balancing against one another the many factors involved in the problem. It is too readily assumed that because a system has been developed over many years it must necessarily be antiquated and inefficient. The truth is that the existing system has arisen out of the necessities of the past and has been based upon practical advantage, as affecting the interest of railway companies, traders and the community alike.

As regards the 20-ton wagon, there is no objection in principle on the part of the coalowners to the use of larger wagons. But even in those branches of the trade in which their use is practicable, the advantage to be derived from them is likely to be small when, after collieries have gone to all the heavy expense necessary to enable them to deal with such wagons, all that the Great Western Railway can offer them is a mere 5 per cent. on the conveyance rate (equivalent to less than one penny per ton in South Wales).

SIXTY YEARS AGO.

"THANK God for ships," said the writer of a leading article in our issue of May 21st, 1869. He was taking an inventory of the food supplies of the country and was endeavouring to show to what pass we should be reduced were our imports of corn, wines, tea, coffee, sugar, cocoa, raisins, early fruits and vegetables, and so forth, cut off. There was, however, one aspect of the food supply question concerning which he could not as yet express himself in thankful terms. The importation of meat in a satisfactory manner from Australia, New Zealand and South America presented problems which had yet to be solved. No one acquainted with the cruelties of the live cattle trade would, our writer said, regard it as the best solution that science, capital, and chemical resources had to offer. There were only two alternatives of any practical worth in existence besides the old-fashioned salting process, a process which dietarians could not countenance. The meat might be preserved and imported in the form of extract prepared by Liebig's process, or it might be preserved and imported in canisters. Our writer objected to the first of these alternatives that the British people could not live permanently on beef tea. To the second he raised the objection that canister preservation necessarily involved the overcooking of the food. If the meat were not overcooked putrescence was inevitable. He did not, however, regard as hopeless the problem of giving the British millions the benefit of the superabundant overseas supplies of meat. His faith in the harmonies of Nature was too strong to encourage any such gloomy view. He was impressed, it would appear, by Mr. Julius Jeffreys' proposed scheme for importing Australian meat in the frozen condition. He had little doubt that it was practicable to carry out the idea. Mr. Jeffreys proposed to use ether as the freezing agency. Our writer would only go so far as to suggest that the cooling produced when gaseous ammonia was liberated from an aqueous solution might possibly be found to be a better method. Granted, however, that meat could be successfully brought over to this country in the frozen condition, two difficulties remained. The freezing and subsequent thawing of animal food perceptibly lowered its quality. Secondly, after thawing the process of deterioration set in with increased rapidity, so much so that the meat would have to be cooked and consumed without the least delay. Ten years were yet to elapse before the steamer "Strathleven" fitted with a Bell-Coleman cold air machine landed a small cargo of frozen Australian meat at London, and by so doing established the economic beginning of an industry which to-day is of vast importance to the welfare of this nation. In 1880, 400 frozen carcases reached this country. In 1927 the number was just under 15,000,000.

American Engineering News.

Tank Reservoirs for Waterworks.

OWING to the hilly character of the city of Cincinnati, it has six reservoirs to provide reserve supply for elevated portions of the residential districts. Two of these are open masonry reservoirs of 96 million and 35 million gallons capacity. Each of the others consists of a group of cylindrical steel tanks or stand pipes, enclosed in masonry walls to give an attractive architectural effect. In most cases the appearance is that of a castle. The latest and largest of these reservoirs consists of fourteen tanks, 70ft. high, half of them 50ft. in diameter and the others 25ft., with a combined capacity of 8½ million gallons. They are all encased in reinforced concrete, cored holes preventing excessive material, but the minimum thickness is 9in. On the inside they are lined with 2in. of gunite or cement grout, applied by compressed air from a cement gun, this grout being reinforced by a continuous sheet of wire netting attached to clips electrically welded to the steel plates. All the tanks rest upon a massive concrete slab, 10ft. thick, 220ft. long and 140ft. wide. The bottom and two rings of shell plating of each tank were erected in place, but 5ft. above the foundation. After testing for water-tightness, the tank was lowered on to a 3in. bed of cement grout, and when this had set the remainder of the steel shell was built up. The surrounding wall is of brick, with base course, parapet and architectural details of concrete.

Treatment of Locomotive Feed Water.

Many American railways have serious troubles owing to bad water in certain districts. A recent report pointed out that it is not always realised what great expense results from bad water, in the way of engine repairs, delays on the road and engines out of service for washing or repairs. It was stated that few natural waters are so good that they would not be improved by some form of treatment. A great amount of damage is done by water that is hard by even a few grains per gallon, especially if there is a fraction of a grain of calcium or magnesium sulphate. In fact, the report concluded that the value of clean soft boiler water, free from carbonic acid and low in sodium sulphate and chloride is so great as to warrant high expense in obtaining it. The usual soda-ash treatment precipitates the calcium and magnesium, but leaves the precipitate, the carbonic acid or the sulphate. The zeolite treatment leaves no precipitate, but does not remove the carbonic acid and the sulphate. Boiler compounds fed to the roadside tanks or the engine boilers precipitate the salts as soft sludge instead of allowing them to form scale on the tubes and plate, but these compounds tend to cause foaming. In one case, water was so bad that treatment to render it chemically satisfactory caused the water to foam to such an extent as to be as unusable as the untreated water. In this case, pure water from a mountain lake was brought down by a pipe line, 140 miles long.

Electric Drive for Rolling Mills.

Application of electric power for American rolling mills was unusually large in 1928, with 163 motors ordered having a total rating of 209,250 H.P., and all of more than 300 H.P. each, as against 116 motors of 170,350 H.P. in 1927. There are now 1681 installations, with an aggregate of 2,161,886 H.P., or an average of 1286 H.P. each, according to figures compiled by the Association of Iron and Steel Electrical Engineers. These are listed below, by classes. The power of individual motors ranges from about 250 to 7000 H.P., or more. Strip and hoop mills lead with 267,405 H.P., an increase of 53,000 H.P., indicating the large place which has been taken by the continuous strip mill. This is indicated also by the small addition of only 1·3 per cent. for sheet and tin-plate mills. The great increase for piercing mills also indicates the advance in production of seamless tubes. The total increase for all motors in 1928 was 10·7 per cent., and 10·3 per cent. for motors of more than 2000 H.P.

Mills.	No. of motors.	Total H.P.	Per cent. increase over 1927.
Blooming	50	228,750	14·1
Bar and billet	157	261,585	9·6
Sheet, bar and skep	79	183,900	8·0
Rail and structural	82	270,300	7·3
Plate	53	125,550	0·0
Strip and hoop	188	267,405	24·7
Merchant	316	259,825	10·4
Sheet and tin-plate	137	185,250	1·3
Rod	79	105,210	26·8
Piercing	41	60,200	17·6
Tube rolling	93	54,090	14·6
Wire	27	10,175	30·0
Wheel	17	12,900	0·0
Cold rolling	115	53,395	5·3
Non-ferrous	225	117,200	5·4
Miscellaneous	22	16,125	3·2
Totals	1,681	2,211,860	10·7

PREPARATIONS for the salving of the Soviet merchantman "Pamat Lenin," which was sunk last year near Pukow, are being made by order of the Chinese Ministry of Communications. Marine engineers and experienced divers are arranging to carry out the operations.

The Paris Fair.

THE annual Industrial Fair in Paris owes its success partly to the facilities it offers to visitors from all over the Continent. So long as it was a purely national event, it failed to make headway against the competition of the International Fair at Lyons, but since it was thrown open to foreign exhibitors the Paris Fair has been growing in importance every year. It may have reached its limit of expansion, unless some means may be found of extending the area beyond the exhibition grounds at the Porte de Versailles, which is quite possible in view of the considerable space that has been rendered available by the suppression of the fortifications. But even as it is, British manufacturers may very well inquire whether it may not be to their interest to take advantage of the Paris Fair to bring their goods before the notice of continental buyers. In these days of increasingly keen competition, it is clear that no opportunities for doing business should be overlooked. They are certainly not neglected by German, American and other manufacturers, whose participation has been growing in importance every year. This year the number of German firms exhibiting was notably large. It seems to have doubled from one year to another. If foreign makers participate so largely they must obviously find that it benefits them to do so. It was certainly worthy of note that within three days of the opening a number of German machines were ticketed as being sold. With a few notable exceptions, the British industry was practically unrepresented. It was rather surprising to find that, at least on the first days of the Fair, the collective stand of British machine tool makers had nothing but a few chucks for drilling machines.

Manufacturers may, nevertheless, have some excuse for hesitating to participate in a Fair which is, necessarily, itself unrepresentative, since they are unable to make a satisfactory display in an exhibition where every conceivable product is crowded into an area wholly insufficient for the purpose, and, while hundreds of applications for space have to be refused, the individual stands for foreign exhibitors are so far reduced in size that it is impossible to show more than a few samples. It is quite useless to exhibit goods that are in direct competition with French productions, unless they are of better quality and are sold at a lower price. The interest of the foreign Fairs lies in the opportunities they offer of bringing to the notice of buyers abroad classes of machinery and products presenting special features and satisfying the needs of foreign users who are interested in anything that will help to cheapen production.

The space allotted to machinery was larger than in previous years and greater prominence was given to machine tools, in which French manufacturers have obviously been making steady progress. A few years ago the attempts of home makers to develop this branch of industry received a serious check, and for the time being many firms were in difficulties, but since motor car manufacturers saw the necessity of meeting foreign competition by "rationalising" and reorganising their production, there has been a big demand for French as well as for foreign machine tools. The Etablissements Huré have always specialised in milling machines, particularly with universal heads, while the Etablissements Cuttat started with small automatic lathes, and both firms showed this year much heavier machines, one of the Cuttat lathes being a compact and powerful machine for chucking short bars to be turned to several diameters. High-duty lathes, radials and milling machines were exhibited by the Etablissements Sculfort-Fockedey and Vautier of Maubeuge. This firm, together with S.O.M.U.A., specialises particularly in the heavier classes of machines. Milling machines are also shown by the Société Alsacienne de Constructions Mécaniques. While the French makers are widening their scope of manufacture, they have only just reached the stage of turning out high-duty machines to meet the modern requirements in mass production, and they can hardly expect to compete successfully with foreign makers, who have the advantage of a long experience and of being able to get their prices down on a big production of machines that provides a considerable surplus for export. This is the case with United States makers who have been supplying large quantities of machines to French users, particularly motor car firms. Thus many American machines were exhibited. Large consignments of machines of all kinds have arrived from the States during the past few months, thereby showing that the French market is worthy of close attention; but as this demand is due to a renewal of factory equipments in order to deal with the labour trouble, it is probable that the time is not far distant when most of the requirements will be satisfied. British machine tool firms have also profited to a certain extent from the French activity, and if the British trade held aloof as a whole from the Fair, it was satisfactory to find that Alfred Herbert, Ltd., maintained the British reputation with its automatic lathes.

The Fair offers most interest as a means of introducing new machines which will assist in economical production. Anything that will save time and labour is attractive to French users, who are compelled now to investigate every means of cutting down costs. The Germans are looking after these requirements. On account of the limited space available, not much could be shown, but in the machine tool section Schiess-Defries had some milling and slotting machines, and H. A. Waldrich, of Siegen, exhibited a large planing machine. In metal-pressing machinery the Germans were also represented, and in the printing machinery section there were several small German machines, one of them having an air pump attachment for picking up the sheets by suction and flattening them out on the pile by compressed air after printing. Alike in metal pressing, metal-cutting machines and small printing machines, there is much to be done. Many orders were taken for a German reciprocating sawing machine for metals. In woodworking machinery the ground is so fully covered by French makers that openings for foreign machinery are small, notwithstanding the manifest superiority of British machines of this kind. The price is against them. Diesel engines were shown by the Société Suisse pour la Construction de Locomotives et Machines, of Winterthur, and some were sold, and in this section at least the British industry was well represented by Ruston-Hornsby heavy oil engines, and by three Ruston steam shovels, while Barford and Perkins, Ltd., exhibited two motor road rollers.

Seeing how restricted they are to space, the practice of most foreign manufacturers is to exhibit one speciality of sufficient interest to attract attention and as likely to create a demand for that type of machine. Even if little business is done, the participation is still regarded as having some definite commercial value. So great is the number of foreign visitors attracted by the situation that the possibilities of business are not limited to what is actually done at the Fair.

The Arapuni (New Zealand) Hydro-Electric Power Development.*

By FREDERICK WILLIAM ADOLPH HANDMAN, M. Inst. C.E.

ARAPUNI is situated on the river Waikato, and is in the northern part of the North Island of New Zealand, about 120 miles south of the city of Auckland. The object of the scheme is to provide electric power for the city and province of Auckland.

The works were designed with a view to the ultimate development of 200,000 B.H.P., the present development being for 75,000 B.H.P., installed in three units of 25,000 B.H.P. each. The normal static head available was 175ft., obtained from the flow of the river Waikato, which draws its waters from Lake Taupo, situated about 70 miles south of Arapuni. The reservoir is 18 miles in length, with an area of approximately 5·33 square miles and a capacity of 5117 million cubic feet. For storage for peak loads each foot of fall of the reservoir is capable of developing 200,000 H.P. for 6½ hours, with a low river flow of 5000 cusecs.

The paper describes at length some operations which were carried out under unusual and difficult conditions The formation at the site of the works is of volcanic deposits, and the geology of the district has received attention. The principal features are:—(1) Geology of the site of the works; (2) river diversion tunnel; (3) upper and lower auxiliary dams; (4) diversion of the river through the tunnel; (5) head-race; (6) main dam; (7) spillway weir; (8) penstock intakes; (9) penstocks; (10) cable tunnel; and (11) temporary ropeway.

The diversion tunnel is 24ft. high and 24ft. wide, with a 6ft. radius curve between the invert and the vertical side walls, and a 12ft. radius arch. Its length is 726ft., and the cross-sectional area is 498·73 square feet. The tunnel is lined with 1 : 2½ : 4 Portland cement concrete, 2ft. thick, and was designed to pass 14,000 cusecs. The level of the reservoir and the flow in the tunnel are controlled by two hydraulically operated regulating valves, installed in the tunnel and operated in a wet pit. The valves are each 21ft. 6in. high and 11ft. 9in. wide, clear opening. They are of the free roller type and were designed to operate under the unusually high head, for this type of gate, of 160ft.

The tunnel lining was subjected to very high velocities of water. The paper describes the sequence of operations and gives the periods during which the tunnel lining was subjected to high velocities of water, culminating in a maximum spouting velocity at the valves of 100ft. per second (68 miles per hour). At this velocity erosion of the concrete took place near the steel work of the valves, but none of a serious nature was observed at other parts of the tunnel. For a period of 6½ weeks the velocity at the valves gradually increased from 46ft. to 100ft. per second. When the velocity reached 85ft. per second (58 miles per hour), the tunnel lining was examined, and there were no signs of serious erosion in any part of the tunnel. The erosion referred to took place subsequently, with increased velocity, during a period of nineteen days.

In order to divert the river through the tunnel and isolate the site of the main dam, two auxiliary dams were constructed, one, the upper, between the tunnel intake and the site of the main dam, and the other, the lower, between the site of the main dam and the tunnel outlet.

At the site of the works the river Waikato flows through a gorge 200ft. wide at the top with cliffs 150ft. high, standing nearly vertically. The width of the river varies from 40ft. to 75ft. at normal summer level, and its depth from 25ft. to 35ft. The average yearly flow taken over a period of six years was 8000 cusecs, and the initial velocity at the site of the dam was 10ft. per second. Floods during the construction period reached a maximum flow of 24,000 cusecs. The river through the gorge was very turbulent even at the lowest levels.

The upper auxiliary dam was designed to retain a flood flow of 14,000 cusecs. Its height was 40ft., with 25ft. below normal water level, and its length was 110ft. The method of constructing the dam presented a very difficult problem, as rock fill would be carried away and both piled and crib cofferdams were impracticable in the strong current. The dam was eventually successfully constructed of gabions weighing 5 tons each, built up in stacks of seventy-five, and eventually 250 tons. The first stacks were built up on the river bank, and thereafter as they were deposited in the river they formed a working platform. The gabions were securely wired together, and the stacks were so built that they remained just on the balance, temporarily anchored by wires. When completed, the anchor wires were cut, and the stacks overbalanced and fell into position in the river. The gabions were constructed of cylindrical wire cages filled with rubble, and were 4ft. 6in. in diameter and 9ft. 6in. long. Their flexibility was such that they readily conformed to the irregularities of the river bed and of each other, and they proved to be eminently suited to the conditions under which the dam had to be constructed, and, moreover, were easily sealed. The final leakage of water through the dam was 2 cusecs, and was dealt with by one 10in. pump. The lower auxiliary dam was constructed, in still water, of rock and earth fill.

The diversion of the river through the tunnel was effected by mining the natural barriers left between the river and the excavated intake and outlet channels with a large number of mines of high explosives in order to blast the rock into as small pieces as possible, so that the *débris* would cause no obstruction in the channels or within the tunnel.

An old river bed, 130ft. above the river Waikato, when deepened and widened, formed a natural head-race about ¾ mile long, to the penstock intakes, into which channel the river flow was diverted on the completion of the main dam. The well-preserved roots and trunks of trees of a forest were discovered a few feet below the surface of the ground. Although the finished gradient of the head-race of 1 in 200 was not a very encouraging one for hydraulic sluicing, this method was successfullly employed for washing out the roots and trunks of trees and for deepening and widening the channel.

The main dam is of the curved gravity type, and 100,000 cubic yards of concrete was used in its construction. It is 192ft. in height and 305ft. long. The spillway weir is situated at the north end of the head-race and has a total length of 732ft., with an effective length of 682ft. The penstock intakes are on the east side of the forebay. Eight intakes have been constructed to provide for the ultimate development of 200,000 B.H.P. The penstock gates, four in number, are of the Stoney sluice type. An electrically driven, automatically operating screen-cleaning apparatus is installed.

The penstocks, three in number, pierce a ridge of country between the head-race and the gorge. They are connected at the top end to the stream-lined intakes and at the bottom end to the steel entrance cones of the Johnson valves of the turbines. They are each a little less than 400ft. in length, with a clear internal diameter of 12ft., and are at a declination of 24 deg. from the horizontal. They are constructed of lap-riveted steel plates ranging from ⅜in. to ⅝in. thick.

The cable tunnel leads from the power house to the cable house at the outdoor transformer station. The inclined section, 247ft. long, rises at an angle of 44 deg. 33 min. It is lined with reinforced concrete, 10in. thick, and its internal dimensions are 7ft. wide and 7ft. 6in. high.

A description is given of a mono-cable temporary ropeway, 8·83 miles long, with observations on essentials for its successful operation.

* Abstract of a paper submitted for discussion before the Institution of Civil Engineers on April 23rd, 1929.

THE INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.

THE fifty-sixth annual general meeting of the Institution of Municipal and County Engineers will be held at Buxton from Wednesday to Saturday, June 19th to 22nd, next, inclusive. The following programme has been arranged:—

On the Wednesday morning, at ten o'clock, the meeting will be opened at the Buxton Pavilion. After the transaction of the usual business a public meeting and conference at the Pavilion will be opened at 11.30 a.m., when visitors and delegates will be welcomed by the Mayor of Buxton (Councillor Stephen L. Pettitt). Lt.-Col. E. B. Martin, D.S.O., M. Inst. C.E., will then be installed as President and deliver an address. For the afternoon alternative visits have been arranged to:—(*a*) Messrs. Earle's Cement Works, Hope Valley; (*b*) the Stancliffe Estates Company's Quarries, Darley Dale; (*c*) Messrs. Constable, Hart and Co.'s Quarries, Matlock; (*d*) Chatsworth Hall; and (*e*) the Derwent Valley Waterworks. In the evening, at eight o'clock, there will be a reception at the Buxton Gardens by the Mayor and Mayoress of Buxton.

On the Thursday the conference will be continued at the Buxton Pavilion, beginning at ten o'clock, when the following papers will be discussed:—(1) "The Evolution of Main Drainage in the City of Manchester," by Mr. J. B. L. Meek, M. Inst. C.E., City Engineer, Manchester; (2) "Notes on By-laws, &c., Relating to New Streets and Buildings," by Mr. T. Peirson Frank, M. Inst. C.E., City Engineer, Liverpool; and (3) "Regional Planning: Some Executive Problems," by Mr. H. H. Humphries, M. Inst. C.E., City Engineer, Birmingham. In the afternoon the conference will be continued in the Buxton Hippodrome at 2.15 o'clock, when the following papers will be discussed:—(4) "The Manchester Ship Canal," by Mr. H. A. Reed, M. Inst. C.E., Chief Engineer, Manchester Ship Canal; and (5) "Municipal Works of Salford," by Mr. R. G. Baxter. At 4.30 p.m. there will be an inspection of Buxton Bathing Establishments. The annual dinner of the Institution will be held in the evening at 7.30 p.m. at the Palace Hotel.

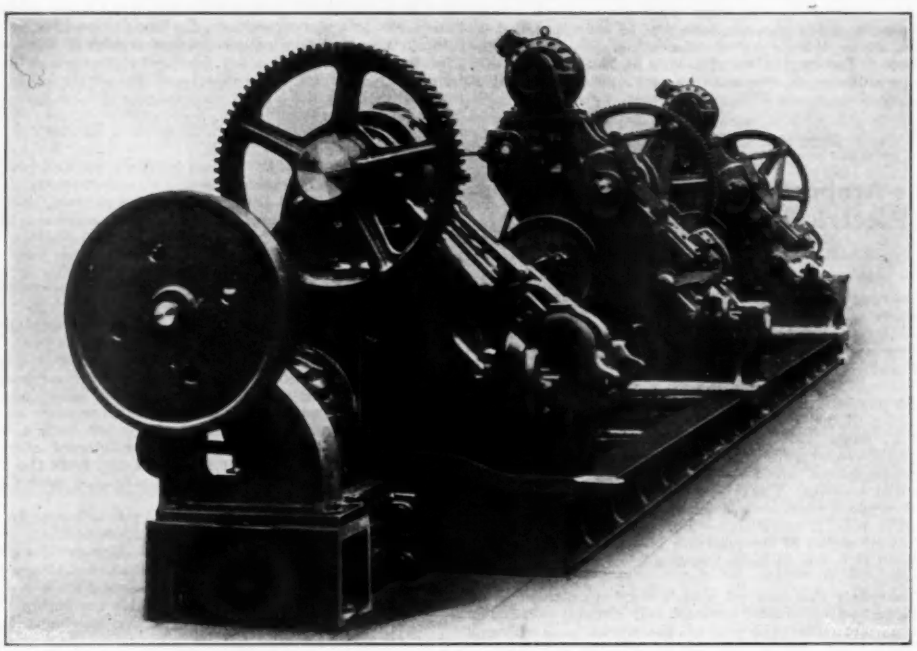
On the Friday there are to be alternative visits to the Manchester Ship Canal and to the Mersey Tunnel and Liverpool Arterial Roads. In the evening, at 7.15 p.m., there will be a ladies' festival of the Municipal and County Engineers' Lodge, No. 3920, at the Palace Hotel, Buxton, followed by dinner and a dance.

On Saturday, June 22nd, there will be alternative visits to (*a*) the Mines Experimental Station at Harpur Hill; (*b*) to Hillhead Quarries and Road Products, Ltd.; and (*c*) the Buxton Bathing Establishments.

IN a circular issued by the American Bureau of Mines, concerning the ventilation of mines, especially in connection with auxiliary units for that purpose, it is stated that in one case a 3ft. by 8ft. reversible fan exhausts 148,000 cubic feet of air per minute at 5·9in. water gauge pressure. The normal drive is a 200 horse-power, 2200-volt, alternating-current induction motor operated by purchased power and connected to the fan shaft by a chain drive and a jaw clutch. The auxiliary drive is a 200 horse-power, four-cylinder fuel oil engine, direct connected by a jaw clutch to the fan shaft. Two men are kept on duty all the time on account of the distant situation. From three to seven minutes are required to make the change from the normal to the auxiliary drive in case of a power interruption. The oil engine is started daily and the fan is operated by it at least twice each week. For the test operations, the change can be made with very little variation in the fan speed. When the power is interrupted, the procedure is to close the door in the fan duct, light the torches on the oil engine, disengage the clutch on the motor, engage the clutch on the oil engine, and as the fan gains speed open the door in the duct.

TRIPLE-HEAD ANGLE PUNCHING MACHINE

JAMES BENNIE AND SONS, LTD., GOVAN, ENGINEERS



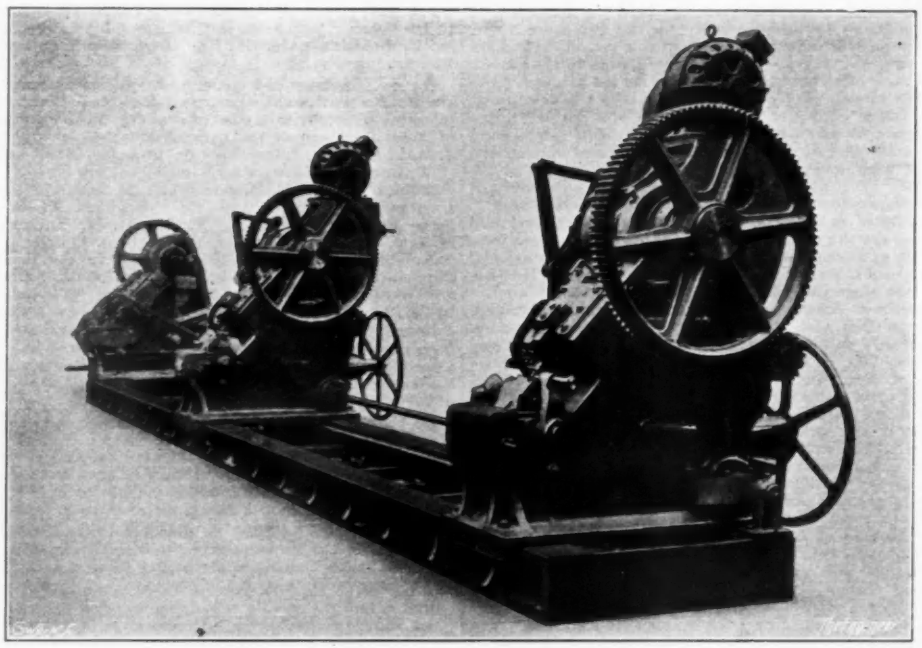
Triple-Head Angle Punching and Cropping Machine.

THE patented triple-head angle punching and cropping machine illustrated herewith has been primarily designed by its makers, James Bennie and Sons, Ltd., Clyde Engine Works, Govan, Glasgow, to facilitate the mass production of steel transmission towers required for the various "grid" schemes now being carried out in this country and for similar schemes abroad. In addition to such towers there are, it is claimed, many other types of structure, such as roofs and steel-framed buildings, for the manufacture of which the machine is suitable.

The machine has three punching heads, which are mounted on a base plate 30ft. in length. The punch slides operate at an angle of 45 deg. instead of in the usual vertical position. This feature has been adopted because it has been found to promote convenience of handling if the angles are operated upon with the heel lying uppermost. The slide of each punching head carries two punches, which are adjustable longitudinally to vary the centres distance and transversely to vary the distance of the holes from the heel of the angle. The punching head shown at the near end in the first engraving is secured to the bed and is stationary. The two other heads can be moved along the bed so as to permit work to be performed on bars of various lengths and requiring holes in various positions. In addition to the two punches the stationary head carries an angle cropper. It is also equipped with a stamping device which impresses identification numbers on the bars when they are being punched.

When the machine is being set for a particular batch of bars the two movable heads are traversed along the bed by means of a rack and pinion movement operated from the hand wheels shown in the second engraving through worms and worm wheels. A screw stop on one of the movable heads is adjusted to give the correct spacing from the holes to the end of the bar. The work is passed into the machine from the end shown in the first engraving. The bar is placed with the heel uppermost so that the inside of the angle rests on the conical rollers provided on the heads for its support. In general the bars would be led on a train of conical rollers from a roller straightening machine to the punching machine.

Each punching head is equipped with an independent electric motor. The stationary head is driven by a direct geared motor, while on the movable heads the transmission is made by laminated belts tightened by means of jockey pulleys. A foot lever mounted on a lay shaft operates three clutches, and by its use the bar inserted in the machine is simultaneously punched with six holes, cropped and stamped. The makers inform us that one firm using the machine was able to turn out from five to ten bars per minute—according to the size of bar—fully punched, typed and cut off. The clutches employed are designed to stop the excentric shaft at the top of the stroke so that the punches and cutter are always open to receive the bars. If desired, one of the movable heads can be put out of action by stopping the electric motor driving it. The machine is equipped with stripping and holding-down gear.



ANGLE PUNCHING MACHINE SHOWING ADJUSTABLE HEADS

THE Canadian Bank of Commerce will erect a new building in Toronto, Ont., 150ft. by 177ft. by 500ft. in height. It will have thirty-five stories above the level of the sidewalk and four stories below. About 8000 tons of structural steel will be required, the contract for which has been awarded to the Hamilton Bridge Works, of Hamilton, Ont.

South African Engineering Notes.

Line to Manganese Field.

THE Minister of Railways recently passed through Parliament a Bill authorising the construction of a railway from Koopmansfontein to Postmasburg, for the exploitation of manganese ore deposits in the latter area. The new line will be built under the agreement recently concluded with the British Swiss International Corporation, Ltd., which will finance the construction and equipment of the railway and any losses on running. The estimated cost of the new line, which will be 65¼ miles long, is £310,420. The estimated expenditure on the first year of working is £69,118 and the earnings £52,187—a net deficit of £16,931. The company undertakes to despatch over the railway not less than 200,000 tons of manganese ore and manganese concentrates from Postmasburg in the first year after the line is opened, and in each subsequent year not less than 350,000 tons. After ten years the Railway Administration will refund the whole amount payable by the company on the construction and equipment of the line. The Railway Board has been assured that the economic prospects of the development of the ore are sound. Mankganene diamond mine will be worked as soon as the railway is built. Two other diamond mines in the vicinity will provide traffic, while asbestos is being mined on a fairly large scale. The importance of the new industry to Natal is that the company has agreed to construct and equip at Colenso or some other site within the Union, between the Natal coalfields and Durban, suitable works with a capacity to treat 50,000 tons of manganese ore per annum, and to convert it into ferro-manganese.

New Outlet for Rhodesia.

Although very large sums have been spent, and are being spent, on the Beira line to Rhodesia, to make it safe under all conditions, it is clear that the Rhodesians are recognising the loss of traffic with which the opening of the new line from the Belgian Congo to Lobito Bay threatens their railways, and that they are casting about for means of preventing or minimising that loss.

It was not the failure of the Beira line to stand up to the heavy demands made upon it in the flood season that was the only consideration in the mind of the President of the Rhodesia Chamber of Mines the other day when he pleaded for another outlet for Rhodesian traffic, *viâ* the new Limpopo Bridge to Delagoa Bay. Mashonaland is very much in favour of the construction of what is known as the Kafue cut-off—a piece of line to connect the railhead at Sinoia with the main line north of the Zambesi in the Kafue area. This would bring Northern Rhodesia and the Southern Congo more than 500 miles nearer to the port of Beira than the present route, which travels round three sides of a rectangle, by way of the Falls and Bulawayo. All the heavy mineral traffic from the north goes out at Beira, and supplies the Rhodesian system with a great proportion of its earnings. So long as there was no other route and rates were regulated by contracts over long periods, it was no great matter whether the traffic went round by Bulawayo or not. But the approaching completion of the Belgian line to Lobito Bay has introduced a new factor, and strengthened the arguments used in Mashonaland in favour of the Sinoia–Kafue cut-off. It is now said that this piece of line is necessary to save for the Rhodesian system the valuable northern traffic. Given this connecting link, the Beira route offers a shorter haul to a great deal of this traffic than the Belgian line.

Matabeleland, in general, and Bulawayo in particular, view the agitation to secure this Kafue link with apprehension. The counterstroke from the Bulawayo point of view is a nearer route between that town and the East Coast ports, particularly Delagoa Bay, *viâ* the new Limpopo Bridge, which is to be connected up with the South African Railway system at Messina. A comparatively short length of track on the Rhodesian side would link the Messina line with the northern route, either by way of West Nicholson or the new Shabani line.

Beryl Ore in Demand.

Some months back a discovery of deposits of beryl ore, containing emeralds, was made in the Transvaal. It attracted little attention at the time, but the position has changed completely since then. Regular parcels of very fine emeralds have been forwarded to London, and have been eagerly bought at very high prices—as much as £160 per carat having been paid. This has led to the formation of other companies, which have taken up areas in the same district. Several of them have been rewarded with discoveries of gems, but it now appears as if there is another and equally remunerative side to the industry. Emeralds (S.A.), Ltd., which holds two large blocks of claims in the emerald fields, has received a communication from the Union Board of Trade and Industries stating that the Board has received an inquiry from the Varlacoid Chemical Company of New York for supplies of beryl ore which contains beryllium. According to the latest information, beryl ore is worth about £2500 per ton. South American beryl ore contains 12 per cent. beryllium, while the Transvaal ore is said to contain 14 per cent. Increased interest is being taken, it is said, in beryllium, and the possibility of its introduction into industry, either as a pure or as an alloying metal. This interest rests mainly on the facts that it is a much lighter metal than aluminium, that it possesses great hardness, and that, unlike aluminium, it has a low expansion coefficient. A valuable property which it possesses is its resistance to atmospheric influences.

New S.A.R. Repair Shops.

The South African Railways Administration is erecting new railway repair shops at Germiston, near Johannesburg. The building when completed will occupy the largest covered area in South Africa. The dimensions are 600ft. by 300ft. by 62ft. in height, and there is to be a crane track, 35ft. above rail level. The roof and sides are to be fitted with wired glass. Steel columns and girders, approximating 2800 tons, are being used in the construction, which is being carried out departmentally. The

value of the machinery to be employed is estimated at £116,000, and when it is in full running order, which may be at the end of the present year, the staff and plant will be capable of dealing with one-third of the total rolling stock in the Union. The plan of the general scheme of extension provides for the erection of another building of the same size for a carpenters' shop, but that will not be proceeded with for another year or so.

New Engineering Concern.

One of the most important new enterprises recently registered at Pretoria is the Wellman Smith Owen Company of South Africa (Pty.), Ltd. This company has been formed with an authorised capital of £100,000 to carry on the business of the Wellman Smith Owen Engineering Corporation, Ltd., of London and Willenhall. The new company is hoping that, among other works, it may secure the contract to build the steel plant for the Pretoria works of the new South African Iron and Steel Industrial Corporation.

Johannesburg Gasworks.

The new gasworks at Cottesloe, Johannesburg, have now settled down to routine operation. The plant is reported to be operating very satisfactorily, and a make of 18,000 cubic feet per ton of coal carbonised is being secured. The average make of the old works was about 14,000, the extra yield at Cottesloe being obtained through the addition of steam, which cools the coke prior to discharge and makes water gas as well. The average daily delivery from the gasometer is now close to the half-million mark, and thus above the maximum ever sent out from the old works. The future growth of the output depends upon the provision of mains to connect up new consumers.

A.S.M.E. Research on the Physical Properties of Steam.*

AT the suggestion of the Executive Committee for the Steam Table Fund, Messrs. G. A. Orrok, D. S. Jacobus, and A. M. Greene, jun., an enlarged special research committee of the Society has been appointed by President Sperry. This committee, headed by past-President Dow as its chairman, will from now on be in executive charge of this research project on the properties of steam and the extension of the steam tables.

It will be recalled that the present investigation of this important subject grew out of an informal conference of experts in this field which was held at Harvard University, Cambridge, Mass., on June 23rd, 1921. At the close of this conference a five-point programme of research was recommended to the A.S.M.E. Research Committee and to the various interests concerned with the generation and use of steam, and favourable consideration was urged. The proposal was accepted by the Committee in the name of the Society and the latter made the necessary arrangements to receive and disburse the funds collected by the Executive Committee named above.

The following is the programme in the form framed at the Cambridge conference :—

(1) The experimental determination of the specific heat of water with the greatest possible accuracy up to its boiling point at atmospheric pressure to make possible a more accurate determination of the mechanical equivalent of the mean heat unit. The determination of the specific heat of water at higher temperatures for the better determination of the heat of the liquid.

(2) The experimental determination of the pressure-temperature-volume relation of superheated steam at high pressures and over as wide a range of superheats as possible.

(3) The experimental redetermination of the density of liquid water over a wide temperature range above that at which satisfactory data are now available.

(4) The experimental determination of the Joule-Thomson cooling effect in superheated steam at pressures up to 600 lb. and at temperatures up to 600 deg. Fah.

(5) Independent measurements of the specific heat at constant pressure of superheated steam at higher pressures than those covered by the Munich experiments as a check on the volume and Joule-Thomson measurements.

In due time work on Part 1 was begun at Harvard University under Dr. H. N. Davis ; Part 2 was undertaken by Dr. F. G. Keyes at Massachusetts Institute of Technology ; and Drs. N. S. Osborne and H. F. Stimson began the construction of their calorimeter for the total and latent heat measurements at the Bureau of Standards.

Beginning with December, 1922, all three of these laboratories made annual reports at a special Steam Table Session of the A.S.M.E. Annual Meeting. These reports will be found in the next following February issue of *Mechanical Engineering*. Reprints of these reports were broadly distributed to the contributors to the Fund and others specially interested in this research. A considerable number were sent to experts on steam residing in Europe. This led to a cordial interchange of data and experiences between the American Committee and the workers in Great Britain, Germany, Switzerland, and Czecho-Slovakia.

At international meetings and conferences of the World Power Conference and other technical bodies interested in this subject, the progress of this research in the United States and the European countries has been noted with interest. Each time the desirability of ultimately developing a steam table which would have universal acceptance has been stressed. This point of view was shared also by those who attended the meeting of I.E.C. Advisory Committee No. 5 on Steam Turbines at The Hague, May, 1928, and the technical sessions of the Centenary Celebration of the Institution of Civil Engineers, London, June, 1928.

Correspondence has passed recently between the investigators and their supporting organisations in Great Britain, Germany, and the United States relative to a proposed international conference of the experts at present at work on the properties of steam. The British Committee has invited these workers in all countries to confer in London next July. This invitation, accordingly, will be one of the subjects to be considered at the first meeting of the re-organised committee.

PERSONNEL OF NEW COMMITTEE.

Dow, Alex., Chairman, President, The Detroit Edison Company, 2000, Second-avenue, Detroit, Mich.

Abbott, William L., Vice-chairman, Chief Operating Engineer, Commonwealth Edison Company, 72, West Adams-street, Chicago, Ill.

Bourne, George L., President, Superheater Company, 17, East Forty-second-street, New York, N.Y.

Davis, Dr. Harvey N., President, Stevens Institute of Technology, Hoboken, N.J.

Dickinson, Dr. Hobart C., Chief, Heat and Power Division, Bureau of Standards, Washington, D.C.

Dollin, Frank, Engineer, Service Department Westinghouse Electric and Manufacturing Company, Lester, Pa.

Goodenough, George A., Professor, Thermodynamics, University of Illinois, Urbana, Ill.

Greene, Dr. Arthur M., jun., Dean, School of Engineering, Princeton University, Princeton, N.J.

Heck, Robert C. H., Professor, Mechanical Engineering, Rutgers College, New Brunswick, N.J.

Jacobus, Dr. David S., Advisory Engineer, Babcock and Wilcox Company, 85, Liberty-street, New York, N.Y.

Keyes, Frederick G., Professor, Research Laboratory of Physical Chemistry, Massachusetts Institute of Technology, Cambridge, Mass.

Marks, Lionel S., Professor, Mechanical Engineering, Harvard University, 215, Pierce Hall, Cambridge, Mass.

Orrok, Geo. A., Consulting Engineer, Room 1208, 52, Vanderbilt-avenue, New York, N.Y.

Pigott, Reginald J. S., Consulting Mechanical Engineer, Stevens and Wood, Inc., 20, Pine-street, New York, N.Y.

Robinson, Ernest L., Turbine Engineer, General Electric Company, Schenectady, N.Y.

* From *Mechanical Engineering*, May, 1929.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Whitsun Holidays.

As was only to be expected, this week has proved uneventful so far as industrial matters are concerned. Midland and Staffordshire works have been idle during a portion of the week, the operatives being on holiday. In a number of cases work was resumed at the mills on Tuesday, in a few more cases mills were running on Wednesday, but many of the plants were idle throughout the whole of the week. The weekly meeting of the Midland iron trade in Birmingham on Thursday was sparsely attended. Manufacturers had already made their arrangements for restarting, and as buying ahead is rarely indulged in, consumers' requirements were naturally small. Producers of iron and steel realised last week that there would be little business to be done on 'Change this week, and few of them considered it worth while putting in an appearance. It is indeed considered improbable that business will get back to normal till the General Election is over and industrialists are able to see just where they stand. The Whitsun holiday with its consequent restriction of productive activity is not likely to involve any inconvenience so far as supplies of materials are concerned. There are few directions in which demand is in excess of supply, the general rule being in the reverse sense. Both producers and consumers of iron and steel are now awaiting the settling down of the country, when they anticipate a considerable release of new business of all descriptions.

The Rise in Steel Prices.

The success which has attended the efforts of steelmasters who were dissatisfied with the decision of the Steel Manufacturers' Association a month ago to maintain prices at a level at which they have stood for some time, notwithstanding the increase in costs of production, to get this decision reversed did not come as a great surprise to Midland manufacturers. The announcement that an advance of 5s. per ton in structural steel prices had been decided upon was no more than they had anticipated a month ago. Engineers were agreeably surprised at the course previously adopted by the Association, and they foresaw that the dissentient steelmasters were likely to gain their end, their case being so strong. They took the precaution of securing fairly considerable tonnages of steel at the old rates. They would undoubtedly have bought larger quantities had millowners been agreeable, but they were not content to accept more than a limited amount of business at the £7 17s. 6d. rate, hoping for better and more remunerative prices as a result of their protest to the Association. They have accordingly no very heavy commitments at the old rates to hamper them in doing business at the new figures. The new prices for the Midland area are :—Angles, £8 2s. 6d. ; tees, £9 2s. 6d. ; joists, £8 2s. 6d. ; ship, bridge and tank plates, £8 17s. 6d. Demand for constructional steel is still slow, the call for plates is slightly better, and half-products sell readily. The motor industry is absorbing good quantities of special steels. There is no change in the selling rates of native small bars or billets, and it is rather surprising that Birmingham merchants have not experienced any growth in the demand for continental steels, which are so much cheaper. Foreign steel bars are still obtainable at £7 2s. 6d. per ton delivered.

Midland Steel Distributing Area.

As a result of a fresh delimitation of territory by the Steelmasters' Association, eight Welsh and border counties, which were formerly included in the Southern area, have been added to the Midlands, viz. :—Glamorganshire, Carmarthenshire, Pembrokeshire, Radnorshire, Cardiganshire, Breconshire, Monmouthshire, and Gloucestershire. The effect of the transfer is to give steel users in those counties the benefit of the lower rate for the Midlands.

Steel Scrap.

The shortage of steel scrap having become very much less acute, consumers are not prepared to pay the high prices which have lately ruled. Sellers have been forced to grant concessions of varying amounts, and £3 17s. 6d. is this week considered a fairly good price to pay. Values are certainly on the decline, and deliveries to South Wales from this area are likely to be made after the holidays at a figure below that here named.

Galvanised Sheets.

Some revival of demand for galvanised sheets is reported as a result of the recent increase in prices. Customers who were inclined to hold off the market for lower prices have now circulated inquiries, and a steady business is being done both on home and export account. Mills in this area continue to quote in advance of the £13 12s. 6d. figure, which is acceptable to some South Wales concerns.

Raw Iron.

Pig iron sales show no improvement. Furnacemen in the Midlands have, for the most part, healthy order books, but there is practically no new business coming in to replace contracts. Small tonnages for prompt delivery are still the subject of inquiry, and in the aggregate they are no mean quantity. Forge and foundrymen are striving to obtain price concessions, but there is no weakening evident on the part of producers, who are adhering to the agreed minimum rates. They assert that there is more probability of prices going higher than of their being reduced. Supply and demand are now about equal, and producers "hold the reins." It is commented upon here that output of pig iron last month was higher than any month for nearly two years. The tonnage produced was 611,300 tons. It is noted also that no less than seven more furnaces were put into commission. The question of merchants' commission, under the new trading scheme, is still under consideration, and another meeting is to be held shortly to discuss the pros and cons of the situation. It is understood that merchants are asking for the commission to be raised from 1½ per cent. to 2 per cent.

Staffordshire Bars.

Staffordshire ironworks engaged in the production of marked bar iron had only a short holiday, the mills being generally busy. There is no great volume of business on manufacturers' order books, but orders come in regularly from week to week and keep the plant employed. Prices are upheld at £12 per ton. In the Crown bar branch business is perhaps a little brighter and more of the orders are coming to local mills, £9 12s. 6d. to £10 being the value put on this class of iron by producers here. Lancashire and other outside makers are competing in this market, and quote slightly lower rates. Little is being done in nut and bolt and fencing bars, the foreigner securing the bulk of the available trade. Wrought iron tube strip is in good demand at £10 17s. 6d. per ton, and rollers have good order books.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Overseas Trade in Textile Machinery.

EXPORT trade in British textile machinery during April showed a welcome recovery from the relatively low figure recorded in the previous month, and hopes are again growing of the aggregate business in the current year reaching that of last year. So far, on the completed four months, however, there is a deficit of over £136,000. During the month under review, shipments of textile machinery amounted to 10,781 tons, valued at £971,002, compared with 9355 tons and £843,072 in the previous month and 9635 tons and £901,193 in April, 1928. Of last month's total, 8690 tons and £765,915 represented spinning and twisting machinery and 1601 tons and £126,453 weaving machinery. Features of the month's shipments were marked improvements in exports to British India, Russia, "other European countries," Japan and Australia. The takings of Germany, the Netherlands, France, China, the United States, and South America were, however, on a smaller scale. British India continued to be easily the most important market during April, shipments thence reaching a total value of £283,621. Japan occupied second place, with exports valued at £93,021, followed by Russia with £61,958, France £57,768, Germany £47,102, the Netherlands £37,188, South American countries £34,233, China £32,658, the United States £29,244, and Australia £18,446, aggregate shipments to "other European countries" increasing from £185,932 in March to £212,936 in the month under review.

University News.

The Court of Governors of Manchester University has decided, on the occasion of the visit of the Institution of Mechanical Engineers to Manchester in June, to confer the degree of Doctor of Science upon Sir Henry Fowler, chief mechanical engineer of the London, Midland and Scottish Railway, and Mr. Daniel Adamson, the President of the Institution of Mechanical Engineers. On his appointment as head of the Civil Engineering Department in Bradford Technical College, Mr. J. B. M. Hay, Lecturer in Engineering at Manchester University, has resigned.

Industrial Results.

Two further financial statements have been issued during the week by Lancashire textile engineering firms. Tweedales and Smalley, Ltd., Rochdale, made a net profit in the year ended April of £70,179, compared

with £77,331 in the previous year and £74,389 in 1926–27, the dividend of 15 per cent. on the ordinary capital being repeated, and the sum of £87,308 being carried forward. Stock-in-trade is valued in the balance sheet at £173,946. Improved financial results have attended the year's operations of Brooks and Doxey (1920), Ltd., West Gorton, Manchester. After allowing £20,000 for depreciation, there is a net profit of £4307 for the past year, compared with a net loss of £17,959 for 1927, and this sum is being applied to the reduction of the debit balance brought forward, which will now stand at £136,270. No distribution on the ordinary shares has been made since 1922.

Gas and Electricity Profits.

As a result mainly of a fall in the price of residual products, the profits of the Bury Corporation gas undertaking have declined from £6834 in the twelve months ended March 31st, 1928, to only £90 in the year just ended. The Gas Committee proposes to raise the sum of £5000 for the purchase of meters and £3000 for the laying of mains. The Electricity Committee of the Corporation reports a profit of £6669 on the year's working. The Committee has received the sanction of the Electricity Commissioners to the borrowing of £20,000 for mains and £10,000 for sub-station equipment.

Non-ferrous Metals.

Buying interest in all sections of the non-ferrous metals market during the past week has been on a very subdued scale locally in consequence of the Whitsun holidays. Not much business has been done in the case of copper, but there has been a recovery of a fair proportion of the heavy loss sustained in the previous week. This has been due less to an improvement in the immediate statistical outlook than to the cable news from the other side of the Atlantic that one of the principal United States producers—the Anaconda Company—proposes to reduce its output to the extent of 10 per cent. Tin has experienced its usual ups and down, but in spite of a very slow demand in the aggregate, values have finished up pretty well where they were a week ago, with prices at the moment of writing, however, still below the £200 mark. Inquiry for lead and spelter has been slow, but here again in both instances prices on balance show very little change on the week.

Iron and Steel.

Deliveries of foundry iron to Lancashire consumers during the past week have been on a reduced scale, owing to the holidays, and for the same reason new business has been virtually stagnant. Quotations, however, are steady to firm, with Derbyshire No. 3 at 71s. per ton, Staffordshire at 72s., Middlesbrough at 82s. 6d. to 83s., Scottish at from 90s. to 91s., and West Coast hematite iron at about 87s. per ton—all including delivery to Manchester works or equal. Bar iron, also, has been exceedingly quiet at £10 10s. per ton for Lancashire Crown quality and £10 for seconds material. The rise in heavy steel materials has caused little surprise locally, and has already, so far as new transactions are concerned, been pretty well discounted for some considerable time ahead. Frame plates, including surface inspection charges, are now at £9 2s. 6d. per ton, general plates at £8 17s. 6d., joists at £8 2s. 6d., and large steel bars at £9 2s. 6d., all subject to rebates in the case of qualified buyers. Boiler plates still range from £9 12s. 6d. to £9 17s. 6d. per ton, according to quality, with small re-rolled bars rather less firm than they have been of late at about £8 10s. per ton.

BARROW-IN-FURNESS.

Hematite.

The position in the hematite pig iron market is about the same as it was a week ago. Makers are well situated as regards contracts, so far as present output is concerned, and there is not sufficient justification at present for a further increase in output. The inquiries are satisfactory, and the tendency to place orders for forward delivery is still noticeable. The demand for special qualities continues to be good. Business with the Continent is maintained, and there are further deliveries of pig iron to America still due. The next few deliveries will complete a very substantial order in the neighbourhood of 40,000 tons placed some time ago. Much of this iron has been conveyed across the Atlantic by Ford-owned steamers. Local steel makers continue to take a fair amount of iron each week, and, as Barrow is assured of a run for some time yet, the requirements will affect the amount of iron available for other customers. Iron ore is in steady demand, with a slightly better trade with ironmakers outside the district. The steel trade is moderate and competition is keen. On the big contracts there is little margin for profit, and it is on the smaller orders that there are better returns. The hoop works are well fixed for orders, mostly on overseas account.

Shipbuilding.

This week Messrs. Vickers-Armstrongs launched from their yard another British submarine of the "P" class, the "Perseus." There is a number of submarines for the British and Chilean Admiralties now being fitted out in the Devonshire Dock, and it is some years since there was so much activity in this department.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Conditions.

IT is significant that many iron and steel firms in the Sheffield district found it impossible to resume work on a full-scale after the Whitsuntide break, which was of normal duration, being from Friday to Wednesday morning in most cases. The fact is that, although there has been a revival in trade, the improvement has not occured in all branches or with all firms, and that is where Sheffield is behind other centres in which the better conditions have been more general and widespread. There are several decidedly weak spots in the industry, and they show no signs of appreciable improvement, whilst other departments which have improved are not finding it easy to maintain their position. Nevertheless, on the whole, there has been an increase in trade, and it is probable that it will continue gradually, so that it would be a mistake to take a pessimistic view of things. It is the uneven conditions, however, which make an unsatisfactory feature of the position.

The Various Departments.

One or two orders for railway material have been obtained by local firms recently, but plants are only moderately employed. The requirements of the British railway companies are not large, although they mean fairly regular orders, and the work for overseas railways has not been on anything like a large scale. Consequently, there is not much work in hand for axles, tires, springs, &c. This has been the case for a long time past, but heavy foundries and forges which have been fairly busy recently are now wanting work. There is a brisk demand for basic steel and the furnaces are working well, but the call for acid steel is still weak and only a few furnaces are operating. It is difficult to say whether the General Election is affecting trade appreciably, but it is certain that its influence on trade is not so great as it used to be. Nevertheless, trade should benefit when the constitution of the Government has been decided.

Prices and Raw Materials.

The advance in the price of steel ship plates, sections and joists by 5s. per ton was by no means unexpected, for there has been a marked upward tendency for some time past. During the last few months raw materials have become much dearer, and it has been suggested that steel manufacturers would be justified in advancing other selling prices, but are compelled to refrain from doing so in order to avoid any possibility of checking the flow of trade. Prices of heavy basic scrap are maintained on former levels, the demand continuing brisk in all steel centres, although supplies are sufficient to meet most demands.

Overseas Trade.

There are interesting points in the recent returns of exports of iron and steel during last month, when the production of steel in the United Kingdom was 808,000 tons, or 50,000 tons less than in March. There were increases in ferro alloys, black plates, wrought pipes and tubes and special steels, and reductions in manufactured steel, hoops and strips and cast pipes, whilst the export of railway steel, axles, tires and wheels was unsatisfactory.

United States Market.

Interesting information regarding the United States market has been provided for Sheffield manufacturers by Mr. A. J. Pack, H.M. Commercial Secretary at Washington. He emphasises that, so far as heavy products are concerned, there is very little scope for Sheffield in the American market. The Germans and Belgians are able to sell structural steel on the Pacific coast, but the British manufacturers do not seem to be able to get down to the necessary price level. There is a substantial importation of steel products on the West Coast owing to the favourable freight rates, but all of that is in the hands of continental suppliers, one contributory cause, no doubt, being that freight from Antwerp is cheaper than that from Britain. There used to be a good field for high-speed steel, but that has practically been eliminated by the Fordney tariff, and it is understood that in the revised Bill even further protection is contemplated.

Work on Hand.

The Crown Agents for the Colonies have recently placed orders with Cravens' Railway Carriage and Wagon Company, Ltd., of Darnall, Sheffield, for three bogie passenger coaches—two first-class and one composite first and second-class—and also for underframes and bogies for two third-class carriages for the Tanganyika Railway. For the contract and purchase department of the Admiralty the firm of Hadfields, Ltd., Sheffield, is to make forged steel cylinder liners, &c.; Cooper and Turner, Ltd., Sheffield, are to provide steel rivets; the Park Gate Iron and Steel Company, Ltd., Rotherham, is to supply steel sheets; and sheets, strips, discs, &c., are to be manufactured by the Rotherham Forge and Rolling Mills, Ltd., Rotherham, and Swift, Levick and Sons, Ltd., Sheffield; Industrial Steels, Ltd., Sheffield, have obtained an order for steel, nickel, chrome, slabs and sheets for the War Office.

Park Gate Company.

The complete battery of gas machines for open-hearth furnaces is now in operation at the works of the Park Gate Iron and Steel Company, Ltd., Rotherham, and has effected considerable economies. The new slag-breaking plant is also at work, and has greatly increased the output of slag for road purposes. The whole of the works have been in continuous operation throughout the past year, and the previous year's record output of steel has been exceeded by 6785 tons. It is stated that the higher prices of fuel and scrap have had an adverse effect on production costs, but that has been offset by the savings which have resulted from expenditure on plant; and as selling prices have on the whole remained stationary, the results for the year are practically the same as for the previous year.

The Lighter Trades.

Conditions in the cutlery and plate trades are far from good. A fair amount of high-class silverware is being made, but there is a poor call for electro-plate. File manufacturers are facing very formidable American competition just now. The tool trade is steady, with orders numerous, but small in bulk. There is a good business being done in stainless plated articles.

NORTH OF ENGLAND.

(From our own Correspondent.)

Advance in Steel Prices.

THE outstanding event in iron and steel trade circles is an advance of 5s. per ton in the price of steel plates, joists, and angles. These quotations have remained remarkably stable. The last change was an advance of 5s. per ton, which was offset by the extra rebate of the same amount, so that in effect the price to those under the rebate scheme was unaltered. But the rise in the cost of production has prompted the steel makers to advance prices 5s. per ton. Ultimately, of course, this will seriously increase shipbuilders' costs, but most of the yards have contracts at the lower prices, which will see them over the next few months. Steel output continues heavy in the North of England. Just at present, however, new business is not large, but the limited buying is not due to absence of customers from the market. The question of delivery is now a difficulty in placing orders, as some manufacturers are sold fairly well ahead. The outlook for the trade generally is regarded as quite bright, and more plant will be set in motion as the supply of raw material increases.

Cleveland Iron Trade.

There seems little prospect of early material improvement of the stringent situation in the Cleveland iron trade. Conditions are not likely to alter sufficiently to admit of enlargement of production to an extent that will meet requirements. More idle blast-furnaces would be rekindled if ample supplies of Cleveland ironstone were forthcoming, but the reopening of inoperative ironstone mines is delayed by the scarcity of miners, many of whom during the long depression in the iron trade have taken up other trades, and drifted away from the district. A very large proportion of the Cleveland iron output is going into direct consumption at ironmasters' own steelworks and foundries, and makers have disposed of their production so far ahead that they have withdrawn from the market. The result is that transactions are confined to sales from merchants' holdings, which are not heavy. Business passing, however, includes occasional sales to firms abroad. Quotations now vary somewhat, as they have become a matter of individual bargaining. No. 1 foundry may be put at 72s. 6d.; No. 3 G.M.B, 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d.

Hematite Pig Iron.

Scarcity of East Coast hematite pig iron is much less acute than is that of Cleveland iron, and quotations are comparatively low, prices having been stationary while values of Cleveland iron have advanced. Merchants are fairly well bought, but they are not pressing parcels on the market, as they look for a rise in prices, and makers are fully sold to the end of next month. Business in hematite has been put through at 74s., but it is doubtful whether extensive sales could be arranged at that figure. Both home and continental buyers are in the market.

Ironmaking Materials.

Foreign ore merchants are making few new sales, but they have good contracts running. Market rates are ruled by fully 23s. c.i.f. Tees for best Rubio. Durham blast-furnace coke keeps steady. Sellers still ask up to 19s. for good medium sorts delivered to the works in this area.

Manufactured Iron and Steel.

Manufactured iron firms are in a strong position. They have a lot of work on hand and expect to book further substantial orders in the near future. Semi-finished steel continues to sell readily, and works are kept running at high pressure to supply customers. Home users of finished steel have been buying freely of late in anticipation of a rise in values, and the advance of 5s. in plates, sections and joists is no more than was generally expected. Business with overseas customers is expanding on an encouraging scale.

Local Orders.

Sir W. G. Armstrong, Whitworth and Co., Ltd., Newcastle, have received a contract for the construction of a combined tanker and whaling factory of 18,000 tons deadweight, specially strengthened for working in the Antarctic ice, for the Kerguelem Sealing and Whaling Company, Ltd., of Cape Town. The propelling machinery is to be twin-screw steam triple-expansion, with oil-fired boilers fitted with superheaters. This important vessel will have a very complete installation for the special work she will be engaged on, and will be laid down at the firm's Walker-on-Tyne shipyard immediately. The machinery, boilers, and some of the special equipment will be manufactured at the company's Scotswood works. Palmers Shipbuilding and Iron Company, Ltd., has received another important repair order. The vessel is the "Valemore," belonging to Furness, Withy and Co., Ltd., which has been aground and is now in the Tyne. The main engines have to be removed, and bottom damage repairs carried out. The work will be done at Jarrow, and will last about five weeks. Palmers Company has ten vessels under repair or on order at its Jarrow and Hebburn docks, including turning of the Hektoria into a whale oil factory. This vessel will arrive next month.

The Coal Trade.

Further impetus to the steady improvement in the coal trade of Northumberland and Durham that has manifested itself this year is given by the placing of the bulk of the Swedish State Railways contract for approximately 300,000 tons of steam coals. Principal shipments will be over the summer, with smaller quantities running into the late autumn. Prices have not been divulged, but are understood to be on the basis of current free-on-board values and freights. Last year Poland secured most of this order, and it was feared would again be the

most successful tenderer, but the fact that they are already well sold for this year may have made Polish shippers less anxious than last year to secure the contract. The outlook continues bright. Business in the last few weeks has been exceedingly good, and there is a quiet confidence that the present general demand for fuel is going to last for some time yet. Collieries are well sold for the remainder of this month, and June portents are of an encouraging kind for the ready disposal of all classes of coal. Prices are keeping up much better than there was any reason to hope they would do when, at the beginning of the year, sellers and buyers alike were trying to gauge summer values. British coals are doing better abroad than at any previous time this year, and the success attained in recent contracts is strengthening the hope that there may be more fuel orders on a large scale to follow.

SCOTLAND.

(From our own Correspondent.)

Continued Quietness.

CONDITIONS in the steel, iron and coal trades generally show continued quietness, and are devoid of any direct indication of an early improvement. Buying, on the whole, is conducted on very cautious lines, and apart perhaps from one or two isolated instances there is no particular feeling of confidence in industrial circles.

Steel.

There is no noticeable change in the position of the steel trade. Business in heavy material is a shade quieter. Specifications for plates are especially disappointing.

Steel Prices.

Owing to higher costs of production, steel makers have for a considerable period complained of the unremunerative level of prices. Consequently, the announcement of an advance of 5s. per ton in ship plates, sections and joists will not occasion any surprise. The new prices are as follows:—Ship plates, ordinary ship quality, £8 12s. 6d., rebate 10s.; sections, £8 2s. 6d., rebate 10s.; and joists, £8 2s. 6d. per ton, rebate 12s. 6d.—all delivered Glasgow stations. This advance in prices can hardly be welcomed by the shipbuilding and marine engineering industries, both of which are just emerging from a long period of depression. Shipbuilders have still a substantial tonnage on the stocks, but the bulk of it is fast nearing completion. The effect of the higher prices of steel is almost certain to be seen in a decreased number of new contracts, and the retarding of the recovery of the industry and allied trades.

Steel Sheets.

The outlook in the steel sheet industry has improved a little. Some fair export orders are reported, and the position, especially with regard to the lighter descriptions, is more encouraging.

Iron.

Bar iron is dull and makers have difficulty in maintaining even a moderate degree of employment. The re-rolled steel department, too, is not so busy, and quotations are maintained on recent levels, chiefly owing to the high cost of imported raw materials. Re-rolled steel bars are still quoted £8 per ton home and £7 15s. per ton export.

Pig Iron.

The recent improvement in hematite is fairly well maintained, and the price is still about 78s. per ton, delivered. Basic iron is strong and nominally 75s. per ton delivered. Foundry qualities are not busy, but minimum prices are unchanged at 75s. No. 1 and 72s. 6d. per ton No. 3 at furnaces.

Locomotive Contracts.

It is reported that William Beardmore and Co., Dalmuir, have secured an order from the Indian State Railways for thirty-two locomotives, the contract price for which is said to be over £200,000. The same firm already has in hand an order for forty-four locomotives for the Indian State Railways.

Coal.

There is little or no change in the position of the coal trade. Home demands have dwindled, and the shipping department shows no improvement so far as round coal is concerned. Restriction of outputs has caused a scarcity in the supply of washed nuts, and these, especially treble nuts, are somewhat firmer. Owing to the present state of the demand, it appears likely that a further reduction in outputs can hardly be avoided. Of the 309,000 tons of coal allocated under the contracts placed on behalf of the Swedish State Railways, 67,000 tons is the amount of Scottish coal included.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

PARTLY as the result of the holidays, and partly as a consequence of the insufficiency of tonnage, the conditions in the steam coal trade have of late been very quiet. There was no pre-holiday rush for coals; in fact, at the end of last week there were no less than thirty-one idle tipping appliances at the various docks in this district To many collieries there is no doubt that the holidays came as a relief, as they had found it difficult to maintain anything like regular working. The tone of the market, as a consequence, suffered, and continued to develop unevenness, but with the collieries as a whole at a standstill for the first three days of this week, which means the loss of about half a million tons in production, hopes are entertained that better conditions will now prevail, and that there will have been a sufficient accumulation of tonnage during the vacation to enable the collieries to effect the clearance of standing stocks and to work without interruption for a time at least. It was not surprising that last week shipments displayed some falling off, and that the total came to just short of 460,000 tons, as against a little over 490,000 tons in the preceding week. The demand for coals for early shipment has been comparatively quiet, but still the market has not been without inquiries for supplies over a period, even up to the end of the year. The welcome news came last week that the Egyptian State Railways have at last bought 180,000 metric tons of Welsh coals for delivery over June, July, and August at Alexandria. It was thought that as the time for which tenders held good had expired there was a possibility of the railways calling for fresh prices, but it now appears that they have arranged for 120,000 metric tons with W. Milburn and Co., and for 60,000 metric tons with Pyman, Watson and Co., the price in each case being 29s. 9d. c.i.f. Alexandria. When tenders went in for this business, the lowest price was that of Tabb and Burletson, of Newcastle and Cardiff, who offered 60,000 metric tons at 29s. 6d. c.i.f., but it appears that this firm has not secured any part of the order, much to the surprise of the market. It is just possible that it preferred to withdraw its offer, seeing that, so far as can be ascertained, the railways did not accept its price within the period for which tenders had to hold good. With regard to the Central Railways of Brazil inquiry for 200,000 tons of superior Welsh coals, the news is not so satisfactory, inasmuch as no part of this order has so far been placed. On the contrary, the report has come to hand that the railways have bought 50,000 tons of Polish coals. It may be that these railways will come on the market later for fresh prices. The only fresh inquiry of note is that for 30,000 tons of best or second-class Admiralty large coals from the New Zealand Government, the coals to be delivered over two months.

Tin-plate Trade.

Last week delegates representing the various unions met at Swansea for the annual conference of the men's side of the Joint Industrial Council for the tin-plate trade, when quite a number of questions affecting the interests of the workmen were discussed and resolutions on them passed. The men strongly insisted upon superannuation scheme proposals being pressed forward, and after a report had been presented to them relating to the new sliding scale proposals for wages regulation, dissatisfaction was expressed that greater progress was not being made towards a settlement. There was a long discussion on the question of the extension of the production capacity of existing works and the building of new works, and the effect such a course would have on the position of the men employed in the trade in the direction of compelling them either to reduce their working hours or in some way to share their work with men who would necessarily be obliged to become surplus. The matter was ultimately referred to the annual meeting of the full Joint Industrial Council, with the request for a statement respecting the existing pooling scheme and its effect upon the workmen. Several other items were considered, including the payment of full wages during the holiday week, which claim it was decided to press forward.

Current Business.

There has not been much business transacted during the past week or so, as holiday conditions have prevailed to a large extent. To those buyers who could ship supplies quickly just before the vacation, colliery salesmen were ready to make concessions in prices, but they were more inclined to stiffen their attitude for coals for loading immediately after the holidays, owing to the curtailment of production and the fact that tonnage was due to arrive and so place colliery undertakings in a stronger situation. At the moment, however, the market is little more than nominal, and it will be next week before anything like settled conditions obtain. Sized and small coals are, however, relatively steadier than large qualities, but coke and patent fuel remain without any special feature. Pitwood shows no improvement in demand, and is quoted about 25s. 6d. to 25s. 9d.

WORLD ENGINEERING CONGRESS IN JAPAN, 1929.

THE following is a list of the papers which have been despatched through the medium of the Institute of Fuel to the World Engineering Congress and the World Power Conference to be held in Tokio in September and October next:—

"Synthetic Fuels and Lubricating Oils," by Professor A. W. Nash, M.Sc., M.I.M.E., F. Inst. F.

"Pulverised Fuel for the Small Unit," by H. W. Hollands and E. C. Lowndes, F. Inst. F.

"The Volumetric Measurement of Coke and Coal," by J. E. Lea, B.Sc.

"The Storage of Steam," by Dr. E. G. Ritchie.

"Coal Cleaning with Special Reference to Japanese Coals," by Dr. R. Lessing, F.I.C., M.I. Chem. E., F. Inst. F.

These papers are additional to those contained in the list which was published in our issue of May 17th.

CONTRACTS.

MARSHALL, SONS AND CO., Ltd., of Gainsborough, as the result of the satisfactory performance of three "Universal" steam road rollers, which were supplied last year to a firm of overseas contractors, have just received from the same firm an order for fifteen further rollers of the same type.

LAUNCHES AND TRIAL TRIPS.

WARDEN, steel twin-screw steamer built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of the Corporation of Trinity House, London, E.C.; dimensions, 172ft. 6in. by 31ft. 6in. Engines, triple-expansion; pressure, 175 lb. per square inch; constructed by the builders; trial trip, May 8th.

FAIRRIVER, single-deck screw steamer; built by Barclay, Curle and Co., Ltd., to the order of Fairport Steamship Company, Ltd.; dimensions, 259ft. by 43ft. 2in. by 20ft.; to carry 2585 tons. Engines, triple-expansion, pressure 180 lb. per square inch; constructed by the builders; launch, May 9th.

LAURELWOOD, steel twin-screw oil tank motor ship; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Messrs. John I. Jacobs and Co.; dimensions, 435ft. by 59ft. by 34ft.; to carry 10,090 tons. Two single-acting oil engines.; launch, May 9th.

PENRITH CASTLE, twin-screw cargo motor vessel; built by Cammell Laird and Co., Ltd., to the order of the Lancashire Shipping Company; dimensions, 460ft. by 60ft. by 31ft. 6in.; to carry cargo. Engines, four-stroke cycle single-acting reversible oil engines of the Werkspoor type; constructed by North-Eastern Marine Engineering Company, Ltd.; launch, May 9th.

DAMIA, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Inland Steamship Company, Ltd., of Winnipeg; dimensions, 260ft. by 42ft. 4in. by 20ft.; to carry 2600 tons. Engines, triple-expansion, pressure 180 lb. per square inch; constructed by Wallsend Slipway and Engineering Company, Ltd.; trial trip, May 10th.

SIR JOHN HAWKINS, twin-screw passenger steamer; built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of the Great Western Railway Company; dimensions, 180ft. by 43ft. 2in. by 15ft. 9in. Engines, triple-expansion, 16½in., 27in. and 46in. by 30in. stroke; pressure, 185 lb. per square inch; constructed by the builders; launch, May 14th.

PRESIDENT DAL PIAZ; built by Swan, Hunter and Wigham-Richardson, Ltd., to the order of Compagnie Generale Transatlantique; dimensions, 377ft. 6in. by 52ft. 8in.; to carry passengers. Engines, geared turbines, Parsons type; a speed of 17 knots was attained on trial trip, May 15th.

SARACEN, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Inland Steam Ship Company, Ltd., Ontario, Canada; dimensions, 260ft. by 42ft. 4in. by 20ft.; to carry 2600 tons. Engines, triple-expansion, pressure 180 lb. per square inch; constructed by Wallsend Slipway and Engineering Company, Ltd.; trial trip, May 17th.

GODFREY B. HOLT, single-screw steamer; built by Cammell Laird and Co., Ltd., to the order of John Holt and Co. (Liverpool), Ltd.; dimensions, 329ft. 6in. by 46ft. 10in. by 27ft. 6in.; to carry cargo. Engines, triple-expansion; constructed by the builders; launch, May 21st.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE ROYAL MAIL STEAM PACKET COMPANY asks us to announce that it has removed its offices from Atlantic House, Moorgate, London, E.C. 2, to Royal Mail House, Leadenhall-street, London, E.C. 3.

THE ENGLISH ELECTRIC COMPANY, Ltd., asks us to announce that its Glasgow office, which was formerly situated at 40, Wellington-street, has been now removed to 200, St. Vincent-street.

JOHN A. SMEETON, Ltd., of 15, Victoria-street, London, S.W. 1, asks us to announce that it has been appointed sole British agent by the Badische Maschinenfabrik und Eisengiesserei of Durlach and Karlsruhr.

THE STANLEY ENGINEERING COMPANY, of Bath, asks us to announce that Mr. F. E. Stevens, having had to retire from business owing to ill-health, the partnership which existed between Mr. H. Jay-Coward and Mr. F. E. Stevens has been dissolved as from May 16th last. Mr. Jay-Coward will continue to carry on the business under the same name and style as before, the services of the old staff being retained.

CATALOGUES.

RUSTON AND HORNSBY, Ltd., Lincoln.—Publication 5568, illustrating various types of "Ruston" excavating machinery in different parts of the world.

BIRMINGHAM TOOL AND GAUGE COMPANY, Grove-street, Winson Green, Birmingham.—Catalogue of "B.T.G." milling cutters, reamers, &c., of all types.

C. G. VOKES, Ltd., 93-97, Lower Richmond-road, S.W. 15.—Particulars of "Vokes Protectomotor" air filters for automobiles, tractors and industrial plant.

BRITISH OXYGEN COMPANY, Ltd., Angel-road, London, N. 18.—A loose-leaf binder containing a number of sheets dealing with oxygen-cutting machines for profile, straight and circular cutting of metals.

THE CASSEL CYANIDE COMPANY, Ltd., 19, St. Vincent-place, Glasgow.—Pamphlets on the case hardening and heat treatment of steel by sodium cyanide, and the "Cassel" cyanide case-hardening furnace.

H. J. H. KING AND CO., Ltd., Nailsworth, Glos.—Catalogue giving particulars of the Whitmore patented brake engine and the overwind prevention gear and Iversen gear for steam and electric winding engines.

STURTEVANT ENGINEERING COMPANY, Ltd., 147, Queen Victoria-street, E.C. 4.—Catalogue No. 1324, describing a large number of different types of turbine vacuum cleaners at work in various industrial buildings.

G. A. HARVEY AND CO. (LONDON), Ltd., Woolwich-road, S.E. 1.—A catalogue of perforated metal work and two leaflets, one on steel plate work and the other illustrating mild steel cable plates for the fixing of electric wires and cables.

ENGINEERING GOLFING SOCIETY.—At the Northern Meeting, held at Gullane No. 1 Course on Whit Monday, May 20th, the "North" Cup was won by B. Hall Blyth, with a net score 79; the second prize going to D. T. Powell after a tie with G. N. Watney at 80.

OPENING AN ATHLETIC CLUB.—An interesting event in the history of James Keith and Blackman Company, Ltd., took place on Saturday, May 4th, when the new sports ground of the "Keith-Blackman" Athletic Club was formally opened by Mr. J. W. Hampsheir, director and general manager, in the presence of about three hundred of the employees of the firm and their wives and friends. The sports ground is situated at Tottenham, near Devonshire Hill, on the new Cambridge-road, and it occupies an area of about six acres. Two cricket and football pitches, and four lawn tennis courts, have been provided.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 21/-
(1) Spanish	21/-
(1) N. African	21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 18 0	—
No. 1 Foundry	3 15 0	—
No. 3 Foundry	3 12 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 14 0	3 14 0
No. 1	3 14 6	3 14 6
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 11 0	—
" " Foundry	3 13 6	—
(3) Northampton—		
Foundry No. 3	3 9 0	—
Forge	3 5 0	—
(1) Derbyshire—		
No. 3 Foundry	3 7 6	—
Forge	3 3 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 4 6 (a) / 4 7 6 (b) / 4 11 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 10 0	—
Second Quality Bars	10 0 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 15 0 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	9 0 0 to 9 2 6	—
Gas Tube Strip	10 17 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 12 6	7 12 6
Sections	8 2 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal. Cor. 24 B.G.)	13 10 0	13 12 6 to 13 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 12 6	—
Angles	8 2 6	—
Boiler Plates	12 15 0	—
Joists	8 2 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 2 6	—
" (Small Round)	8 10 0	—
Hoops (Baling)	10 0 0	9 15 0
" (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
" (Lancs. Boiler)	9 12 6 to 9 17 6	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	7 0 0	—
Hoops	9 10 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	8 5 0 to 8 15 0	—
Billets and Sheet Bars	6 7 6 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 12 6 to 13 15 0	—
Angles	8 2 6	—
Joists	8 2 6	—
Tees	9 2 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 15 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/3 to 18/9
Block Tin (cash)	198 5 0
" " (three months)	201 0 0
Copper (cash)	71 17 6
" (three months)	71 15 0
Spanish Lead (cash)	23 13 9
" " (three months)	23 13 9
Spelter (cash)	26 15 0
" (three months)	26 15 0
MANCHESTER—	
Copper, Best Selected Ingots	77 5 0
" Electrolytic	84 10 0
" Strong Sheets	112 0 0
" Tubes (Basis Price), lb.	0 1 3½
Brass Tubes (Basis Price), lb.	0 1 1½
" Condenser, lb.	0 1 3½
Lead, English	25 12 6
" Foreign	23 17 6
Spelter	26 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/11 per lb.	
Ferro Tungsten	2/9 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£25 0 0	7/6
" " 6 p.c. to 8 p.c.	£24 0 0	7/-
" " 8 p.c. to 10 p.c.	£23 10 0	6/-
" " Specially refined		
" " Max. 2 p.c. carbon	£38 0 0	12/-
" " " 1 p.c. carbon	£40 0 0	15/-
" " " 0·70 p.c. carbon	£45 0 0	17/-
" " " carbon free	1/2 per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
" Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
" " 75 p.c.	£19 10 0 scale 6/- per unit	
" Vanadium	13/- per lb.	
" Molybdenum	4/- per lb.	
" Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/4 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13 6
" " Eli	14/3
" " Splint	15/6 to 16/3
" " Trebles	14/3
" " Doubles	13/6
" " Singles	12/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
" " Jewel	17/6
" " Trebles	13/9
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	12/- to 13/6
Screened Navigation	17/6
Trebles	14/- to 14/6
Doubles	13/3
Singles	12/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/6
Trebles	14/-
Doubles	13/-
Singles	12/-

ENGLAND.

	Inland.
(8) N.W. COAST—	
Steams	24/- to 25/-
Household	38/- to 51/-
Coke	23/6 to 24/-
NORTHUMBERLAND—	
Best Steams	14/6 to 15/-
Second Steams	13/6 to 13/9
Steam Smalls	9/6 to 10/6
Unscreened	13/- to 13/3
Household	21/- to 26/-
DURHAM—	
Best Gas	15/6
Second	15/- to 15/3
Household	21/- to 27/-
Foundry Coke	21/- to 26/-
SHEFFIELD—	
Best Hand-picked Branch	27/- to 28/6 —
Derbyshire Best Bright House	20/- to 23/- —
Best House Coal	19/6 to 20/6 —
Screened House Coal	17/6 to 18/6 —
" " Nuts	16/- to 17/6 —
Yorkshire Hards	15/6 to 16/6 —
Derbyshire Hards	15/6 to 16/6 —
Rough Slacks	8/6 to 9/6 —
Nutty Slacks	6/- to 7/- —
Smalls	2/- to 4/- —
Blast-furnace Coke (Inland)	14/6 at ovens —
Furnace and Foundry Coke (Export), f.o.b.	20/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/- to 20/6
Second Smokeless Large	19/6 to 20/-
Best Dry Large	19/- to 19/6
Ordinary Dry Large	18/- to 18/6
Best Black Vein Large	19/- to 19/6
Western Valley Large	18/6 to 19/-
Best Eastern Valley Large	18/3 to 18/9
Ordinary Eastern Valley Large	18/- to 18/3
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	12/6 to 13/-
Washed Nuts	20/- to 23/-
No. 3 Rhondda Large	20/6 to 21/-
" " Smalls	15/- to 15/6
No. 2 " Large	17/6 to 18/-
" " Through	16/- to 17/-
" " Smalls	13/- to 13/6
Foundry Coke (export)	26/6 to 36/-
Furnace Coke (export)	21/- to 23/-
Patent Fuel	20/6 to 21/6
Pitwood (ex ship)	25/6 to 25/9
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	33/- to 36/-
Seconds	27/6 to 30/-
Red Vein	23/- to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	40/- to 44/-
Beans	23/6 to 25/6
Peas	17/6 to 18/6
Breaker Duff	9/- to 9/6
Rubbly Culm	9/6 to 10/-
Steam Coals:	
Large	18/- to 19/-
Seconds	17/- to 18/-
Smalls	10/6 to 13/-
Cargo Through	15/9 to 16/9

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our Correspondent in Paris.)

Rhone Navigation.

THE President of the Lyons Chamber of Commerce has made an appeal to the Swiss to aid in the carrying out of the vast undertaking which is to render the Rhone navigable between Geneva and Marseilles. While traffic is possible between Marseilles and Lyons, the river above the latter town is quite unsuitable for navigation owing to the variations of level and the high velocity of the current, and the most convenient way of regulating the river and providing the depth necessary for the traffic is to raise the level of the Lake of Geneva. The Swiss hesitate to embark upon such a scheme, and the French are endeavouring to convince them that their interests lie in facilitating the canalising the Rhone whereby the transport of heavy and cumbrous goods between the Mediterranean and Switzerland would be enormously cheapened. The object of canalising the Rhone is to divert traffic from the central European waterways to the Mediterranean, and Marseilles has prepared for this by the construction of the Rove Tunnel and the Canal to Arles. It will be a costly undertaking, and will probably necessitate the construction of lateral canals. Several schemes are under consideration, one providing for the construction of an extensive port on the left bank of the Rhone at Lyons. The considerable differences of level will be utilised for the production of electricity, the total quantity of which, it is declared, may be as much as 5000 million kilowatt hours per year. Allowing for one half of that amount there would be sufficient energy available for industrial purposes and for railway electrification, and a further source of revenue would be provided by the carrying out of extensive irrigation works. It is quite comprehensible, therefore, that the French should seek to enlist the good services of the Swiss in order to increase the volume of the Rhone. Although the scheme was decided upon long before the war, and was revived in 1918 when the Rhone Committee was formed, nothing could be done until the currency was stabilised, and during the past few months the State has hastened forward preliminary arrangements so that practical work may be soon begun.

Coal.

The attempt of the economic committee at Geneva to provide a solution of the coal trade crisis is likely to fail in view of the opposition of the Comité des Houillères de France. The committee's suggestions were mainly in favour of suppressing duties and taxes and anything in the nature of dumping and of creating an international body to regulate production. Monsieur de Peyerimhoff, President of the Comité des Houillères, dealt at considerable length with matters affecting the coal trade situation, and said that there could be no international control of the industry until there was a complete national organisation, which was far from being the case. He said that, while the colliery industry was passing through a serious crisis, the situation had improved, and he suggested that it would be better to let coalowners continue to work out their own salvation. There were, he said, more miners at work in Great Britain, and it may be assumed that the opposition of Monsieur de Peyerimhoff to the committee's recommendations is due more particularly to the better outlook for coalowners in the Nord and the Pas de Calais, who have succeeded, by good organisation, in placing the industry on a much more satisfactory basis, and French coalowners presumably fear that they may not be favoured by a policy which would benefit more particularly those countries with a surplus output of coal.

Maritime Traffic.

Since the big French shipowners adopted the British system of running tramp steamers as part of their traffic, the tonnage carried has notably increased, and although the figures for last year are not yet complete, it is clear that French ships are carrying a larger share of the tonnage to and from home ports. At the beginning of the present year the tonnage of merchant ships was 3,396,854 tons, or practically the same as in the preceding year. In 1926 French bottoms carried nearly 50 per cent. of the traffic to and from home ports, as compared with rather less than 31 per cent. in 1913. Since then the traffic of the leading ports has increased to more than 45,500,000 tons in 1928, or two million tons in excess of the total for 1927 and seven million tons more than in 1926. The improved situation of French shipping is due largely to the colonial trade. Last year French vessels carried 97 per cent. of the goods exported to the Colonies and 70 per cent. of the imports.

Town Refuse.

The quantity of refuse collected daily in Paris is about 800,000 tons, most of which is now incinerated at the works at Issy-les-Moulineaux and Saint-Ouen, the combustion being effected entirely with the refuse itself. Last year the waste gases at Issy-les-Moulineaux produced electricity equivalent to 26,500,000 kilowatt hours. A considerable amount of valuable fertilising products is recuperated, and an important source of revenue is derived from the manufacture of bricks from the clinkers or slag. All metallic substances are first removed from the slag by magnetic separators. Lime is employed as a binding material, and after various operations the bricks are subjected to steam under pressure. Finally they are dipped in a solution to prevent exudations. The bricks, which contain a high proportion of silicon, are declared to be of good quality. Last year the two works produced 14 million bricks. This, however, did not absorb anything like the total quantity of 200,000 tons of slag, the remainder being disposed of for other purposes. These slag bricks are employed extensively in and around Paris for foundations and inner walls, their appearance rendering them unsuitable for external work. The incineration of the refuse is carried out by an independent company which started by equipping the older works with furnaces using coal, and the system has been improved until, with the new plant at Issy-les-Molineaux, no coal is employed, and the vegetable refuse in summer produces about the same number of heat units as the same weight of drier refuse collected in winter.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

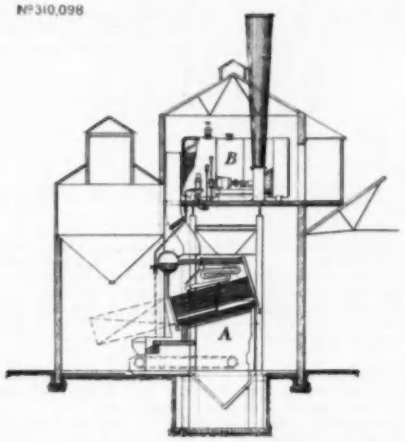
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

310,098. January 26th, 1928.—BOILER PLANTS, P. St. G. Kirke, 50, Broadway, Westminster.

The inventor proposes to provide for peak-load conditions on a steam power plant by utilising two boilers in series. The main water-tube boiler A works, for instance, at a pressure of 335 lb. per square inch, and the auxiliary fire-tube boiler B at a pressure of 100 lb. per square inch. The feed water is first

Nº 310,098



delivered to the fire-tube boiler, and is then pumped into the main boiler. It is suggested that in the case of heavy peak loads the feed to the fire-tube boiler may be discontinued and its store of hot water used solely for the feed of the water-tube boiler. It is explained that as the fire-tube boiler is used for raising steam, which may be utilised in a prime mover, its temperature cannot fall below the dew point, and, consequently, corrosion of its heating surfaces will not develop.—*April 25th*, 1929.

INTERNAL COMBUSTION ENGINES.

310,220. May 31st, 1928.—ENGINES OPERATING WITH PULVERISED FUEL, *J. Y. Johnson*, 47, *Lincoln's Inn-fields, London*.

The inventors propose to supply an internal combustion engine with the solid residue of a low-temperature carbonisation process, in conjunction with superheated steam, so that the two

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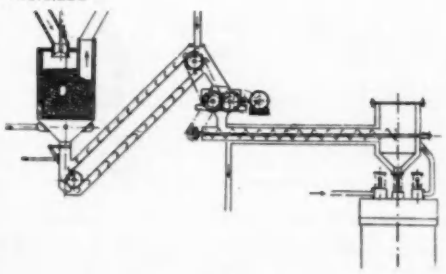
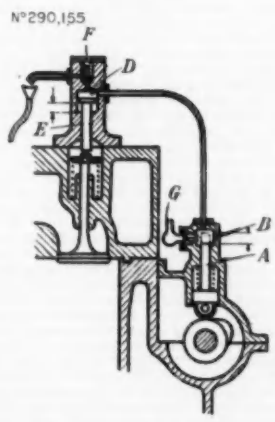


may react, one upon the other, within the engine cylinder to produce "water gas." The solid fuel is taken hot from the retort, is pulverised in a mill from which air is excluded, and delivered to the engine at a temperature of about 600 deg. Cent. If necessary, the fuel is heated in process of conveyance by means of the engine exhaust gases.—*April 25th*, 1929.

290,155. March 6th, 1928.—PRESSURE LIQUID CONTROLLING MEANS FOR VALVES, Waggon- und Maschinenbau Aktiengesellschaft Görlitz, of Görlitz, Germany.

This invention relates to the hydraulic control of valves for

Nº 290,155



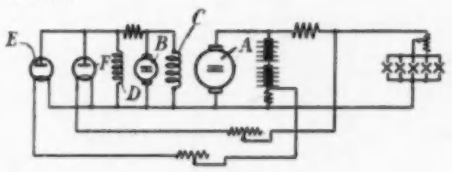
internal-combustion engines and other machines, and the accompanying illustration shows an inlet or exhaust valve operated in this manner. The driving piston A is worked from the cam shaft and delivers the operating liquid from the pressure chamber B through a pipe to the pressure chamber D, which, with its operating piston E, is arranged directly over the valve which it is desired to work. The fluid is drawn into the pressure chamber B through the suction valve G, the stroke of the piston A being such that a larger volume of liquid is delivered to the pressure chamber D than is actually required to fill it. This being so, the excess liquid is by-passed through the valve F arranged at the top of the control mechanism, and it carries with it any bubbles of air or gas which may have been delivered to the upper pressure chamber. When oil is used as the operating medium, the suction valve and the overflow valve F are connected to the lubricating system of the engine, and the operating oil is taken from the oil supply and returned to a storage tank.—*April* 18th, 1929.

DYNAMOS AND MOTORS.

309,631. January 14th, 1928.—VOLTAGE-REGULATING DEVICES FOR SUPPLY SYSTEMS COMPRISING VARIABLE SPEED-DYNAMOS, *Stanley Gordon Sinclair Dicker, of* 20 *to* 23, *Holborn, London, E.C.* 1.

The main dynamo, as used for train lighting, is shown at A and a small exciting dynamo at B. Across the field windings C and D are connected two diode valves E and F. As the speed

Nº 309,631

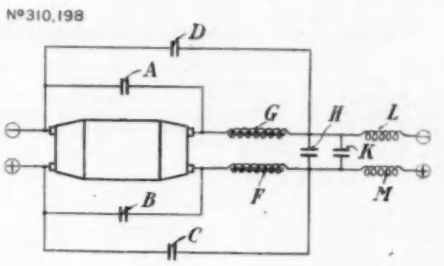


increases and the voltage of the main dynamo tends to become excessive, the heating of the filaments of these two valves reduces the resistance, thus shunting current away from the field windings C and D, which belong to the main and exciting dynamo respectively. The voltage of the main dynamo is therefore maintained more or less constant irrespective of the speed.—*April 15th*, 1929.

310,198. May 5th, 1928.—ELECTRICAL TRANSFORMERS, The M.-L. Magneto Syndicate, Ltd., and Ray Harcourt Woodall, both of Victoria Works, West Orchard, Coventry.

The scheme described in this specification is for the purpose of smoothing out the ripples or other disturbances which occur with rotary transformers having two armature windings and two commutators, one of which takes current from a low-tension accumulator and the other supplies high-tension current

Nº 310,198



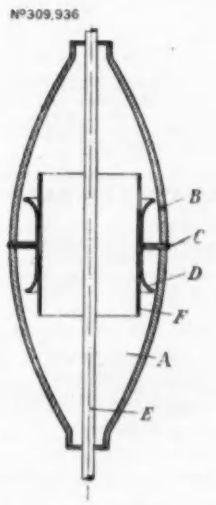
to power amplifiers. Condensers A and B of from 2 to 4 microfarads are connected between each pair of positive and each pair of negative brushes, as shown. Another condenser C of the same capacity is connected between the positive input lead and a point beyond the choke. Similarly, a condenser D is connected to the negative input lead and the negative output lead, which contains a choke G. Two other condensers are provided at H and K. High-frequency chokes L and M may also be employed.—*April 25th*, 1929.

TRANSMISSION OF POWER.

309,936. January 18th, 1928.—LEAD-THROUGH INSULATORS *Justin Erwin Pollak, of* 20 *to* 23, *Holborn, London, E.C.* 1.

This specification describes a lead-in insulator, capable of withstanding surge oscillations or high-frequency oscillations caused by atmospheric disturbances. Material A—the nature

Nº 309,936



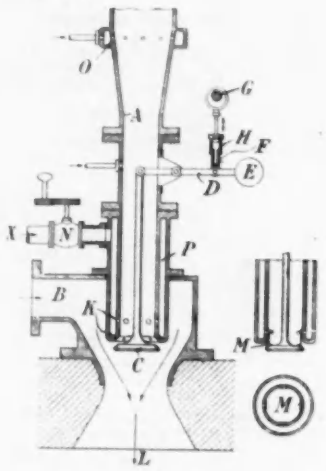
of which is not specified—is contained in a supporting insulator B. The outer electrode C projecting into the insulator B has curved end portions D, forming a metallic sleeve. The lead-through pin E forms the second or inner electrode. At F there is a layer of material having high dielectric strength.—*April 18th*, 1929.

FURNACES.

297,835. September 25th, 1928.—Furnaces for Pulverised Coal, Stephen Löffler, of 6, Witzlevenplatz, Charlottenburg, Berlin.

The pulverised coal is admitted to the combustion chamber through the feed pipe A, and mixes with the air of combustion entering through inlet B. A regulator C at the mixing point is adjusted by means of a rod D with counterweight E, and a sliding member F, operated from the shaft G by means of an excentric. The position of C can also be independently adjusted by means of the screw-down device H. Air under pressure, coming from inlet X, is admitted at the mixing point

N° 297,835



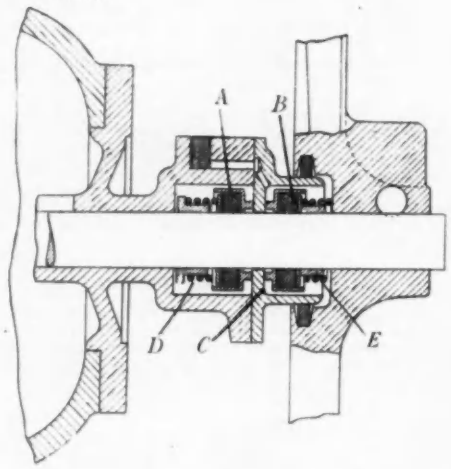
through the openings K. The mixture enters the combustion chamber at L. The openings K admitting the air under pressure, can be influenced by the regulator C—for example, by the damper strips M—and the air under pressure can also be regulated by means of a throttle at N. Air under pressure can be admitted, in a continuous manner—*e.g.*, through the openings K—or in an intermittent manner through the openings O. Before reaching the discharge openings K the air under pressure is preferably passed into an annular chamber P, surrounding the feed pipe for the pulverised coal, in order to prevent the air of combustion, which is usually strongly preheated, from unduly heating and decomposing the coal.—*April 18th*, 1929.

PUMPING AND BLOWING MACHINERY.

309,060. December 3rd, 1927.—Glands, T. Hall and Son, Ltd., and C. E. Garrod, Masboro'-street, Rotherham.

The inventors aim at the reduction of the frictional losses in the gland boxes of refrigerating machines, by the adoption of two "valves" A and B, each of which is lightly pressed up

N° 309,060



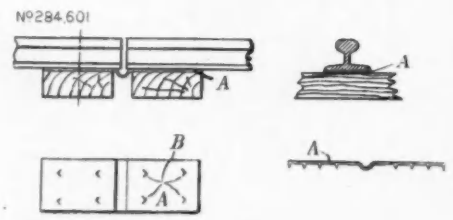
against a partition C, by springs D and E. By this arrangement the valve A seals the shaft against internal pressure, and the valve B against internal vacuum. The actual pressure of the valves on their faces is dependent principally on the pressure they have to resist.—*April 3rd*, 1929.

TRAMWAYS AND RAILWAYS.

284,601. January 12th, 1928.—Electrical Rail Connectors, Adolphe Alexandre Joseph Briois, of 2 rue de Béarn, Saint Cloud (Seine et Oise), France, and Paul Felix, Raymond Bertrand, of 93 rue de Rome, Paris.

A bond consisting of a substantially rectangular plate A

N°284,601



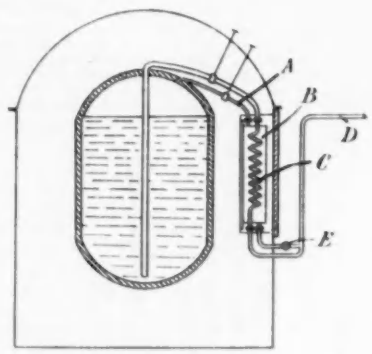
composed of copper is interposed between the feet of the rail ends and the sleepers. In installing the bond, the upper surface of the plate A is cleaned. The under side of the feet of the track rails adjacent to the ends is also cleaned and the plate A is interposed between the feet of the rails and the sleepers as shown. The portions of the bond member A engaging with the sleepers are provided with downwardly projecting teeth B.—*April 12th*, 1929.

MISCELLANEOUS.

305,974. November 23rd, 1927.—A Process for the Absorption of Gases in Liquid Gas Apparatus, Gesellschaft für Industriegasverwertung mit beschränkter Haftung, 39, Gradestrasse, Berlin-Britz.

This inventiln appears to be concerned with the transport of gases, such as oxygen, in the form of liquid, and aims at the prevention of the serious increase of pressure in the container

N°305,974

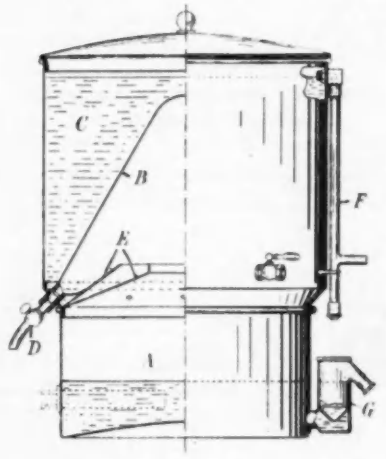


by the evaporation of the liquid. Any gas which may be evaporated passes by the pipe A to the box B, which is full of silica gel, and is there absorbed. This action only takes place at a low temperature, so the gel box is provided with a coil C, which is cooled by outward-going liquid passing away at D. When the container is emptied the gel box is heated and the contained gas is expelled by way of the branch E.—*March 25th*, 1929.

308,956. December 30th, 1927.—Distillation Apparatus, J. Stone and Co., Ltd., Deptford, and R. C. B. Swindale, 153, Waller-road, New Cross, London, S.E. 14.

This evaporator is intended for the production of comparatively small amounts of distilled water, and is characterised by the fact that the steam rising from the evaporating pan A is condensed on the inner surface of the cone B, which is cooled by

N° 308,956



the water jacket C. The condensate trickles down the sides of the cone into the gutter at the bottom, whence it may be drawn off by the cock D. The gutter is protected from the heat of the rising steam by the baffles E E. The cooling water is discharged by the pipe F, into the trap G, which regulates the height of the water level in the evaporating pan.—*April 2nd*, 1929.

309,393. January 9th, 1928.—Process for Coating Metals, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C. 2, and William Singleton, of Research Laboratories of the General Electric Company, Ltd., Wembley, Middlesex.

The object of this invention is to provide an improved process for obtaining a protective coating on metals or alloys. In order to increase the ohmic resistance of a pure iron such as electrolytic iron, it has been proposed to heat the iron to a temperature of 600 deg. Cent.—700 deg. Cent. in a current of silicon tetrahydride. The process according to the invention consists in treating the heated metal or alloy, in sheet, powder or other form, with silicon tetrachloride. The metal or alloy is heated during the process to a red heat. The process produces a superficial layer which may consist of silicon, or of an alloy of silicon and the underlying metal, or a mixture of silicon and a silicon alloy, the composition depending on the nature of the underlying metal and the temperature at which the treatment is effected. The resultant silicon-impregnated product may then be annealed in hydrogen or other non-oxidising atmosphere. The powdered metal, for example, iron or an iron alloy, is placed in a tube through which a current of inert gas, such as nitrogen, is passed. The vapour of silicon tetrachloride is then mixed with the gas current passing through the tube and the tube is heated to a red heat. The silicon tetrachloride is decomposed and the metal powder in the tube becomes coated with silicon or a substance containing silicon. The treatment with silicon tetrachloride is continued for a sufficient length of time, which must be determined by trial, and the whole is then allowed to cool. In some cases it may be necessary to give the product an annealing treatment, and this can be carried out in any suitable manner taking precautions to prevent oxidising the silicon coating; for example, the product may be again heated in an inert atmosphere to the required temperature and allowed to cool slowly. The final product consists of a powder in which the particles are coated with a protective coating. The purposes to which metals treated in accordance with the invention may be put, are probably many, but only three examples are given. Iron powder treated in the manner described may be packed into an insulating tube, and may then be used as the resistor in an electric heating element. Similarly, a resistance wire for use in an electric heating element may be given a protective coating of silicon. Furthermore, the coating produced in accordance with the invention has useful acid-resisting properties, and acid-resisting vessels may be made of iron or iron alloys coated in this way.—*April 9th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Water Engineers.—Birmingham. Summer general meeting. For programme see page 352, March 29th, 1929.

Physical Society.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "A Hygrometer for Use in Timber Seasoning Kilns," by Dr. Ezer Griffiths, F.R.S.; "Experiments on Magnetostrictive Oscillators at Radio Frequencies," by Dr. J. H. Vincent. A demonstration of an apparatus for measuring the thermal expansion of glass will be given by Professor W. E. S. Turner. A demonstration of the Flutter model aeroplane wings will be given by Mr. R. A. Fraser and Mr. W. Duncan. 4.45 p.m. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.

SATURDAY, MAY 25TH.

Institution of Engineers-in-Charge.—Visit to the Exhibition at the Imperial Institute, South Kensington. 3 p.m.

WEDNESDAY, MAY 29TH.

Institution of Engineers-in-Charge.—At the Electric Lamp Manufacturers' Association, Lighting Service Bureau, 15, Savoy-street, London, W.C. 2. "The Lighting of Public Institutions, with Special Reference to Economics," by Mr. W. J. Jones. 7.30 p.m.

FRIDAY, MAY 31ST.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "The Air Pump: Past and Present," by Dr. E. N. da C. Andrade. 9 p.m.

TUESDAY, JUNE 4TH.

Illuminating Engineering Society.—In the Lecture Theatre of the Royal Society of Arts, 18, John-street, Adelphi, London, W.C. Annual general meeting. Annual report of the Council. "Some Further Applications of Synchronously Intermittent Light for Revealing Moving Machinery," by Dr. J. F. Crowley. 6.30 p.m.

TUESDAY TO FRIDAY, JUNE 4TH TO 7TH.

Institution of Gas Engineers.—At the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. Annual general meeting. 10 a.m. each morning.

WEDNESDAY TO SATURDAY, JUNE 5TH TO 15TH.

International Foundry Trades' Exhibition.—Royal Agricultural Hall, Islington, London, N. 1.

FRIDAY TO THURSDAY, JUNE 7TH TO 13TH.

Institution of Gas Engineers.—Visit to Berlin for the meetings of the German Gas and Water Association, and to visit the German Gas and Water Exhibition.

THURSDAY TO SATURDAY, JUNE 6TH TO 15TH.

International High Tension Conference.—Paris. For provisional details see page 413, April 12th, 1929.

TUESDAY TO SATURDAY, JUNE 11TH TO 22ND.

Institution of Electrical Engineers.—France. Summer meeting. For programme see page 331, March 22nd, 1929.

TUESDAY TO FRIDAY, JUNE 25TH TO 28TH.

Institution of Mechanical Engineers.—Manchester. Summer meeting. For programme see page 302, March 15th, 1929.

TUESDAY, JULY 2ND.

Institution of Electrical Engineers: South Midland Centre.—Summer meeting. Visit to the Avonmouth Docks. Assemble main booking hall, G.W.R., Snow Hill, Birmingham. 11 a.m.

TUESDAY TO THURSDAY, JULY 2ND TO 4TH.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. Summer meeting in Newcastle-upon-Tyne, jointly with the Institution of Engineers and Shipbuilders in Scotland. "The Story of Safety at Sea," by Sir Westcott S. Abell; "Developments in the Uses of Electricity," by Mr. R. P. Sloan; "The Applications of Monel Metal in Engineering and Shipbuilding," by Mr. John Ireland; "Some Notes on Damage to Ships," by Mr. J. L. Adam.

TUESDAY TO FRIDAY, JULY 2ND TO 5TH.

British Waterworks Association.—Portsmouth. For programme see page 447, April 19th, 1929.

WEDNESDAY TO FRIDAY, JULY 10TH TO 12TH.

Electrical Association for Women.—Fourth Annual Conference at the North-East Coast Exhibition, Newcastle-on-Tyne.

The Royal Aeronautical Society.—During the International Aircraft Exhibition a conversazione will be held by the Royal Aeronautical Society in the Science Museum at South Kensington, by permission of Colonel Sir Henry Lyons. The date chosen, July 25th, is the twentieth anniversary of Bleriot's flight across the English Channel. It is hoped that the historic machine in which the flight was made will be on view in the Aeronautics Section. The Wilbur Wright Memorial Lecture will be delivered during the evening by Hon. Wm. MacCracken, jun., Assistant Secretary of State for Commerce of the National Advisory Committee for Aeronautics of the United States of America.